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ABSTRACT

This document is a compilation of environmental activities related directly to the environment in Georgia. A description of the physiographic characteristics of Georgia is presented upon which the activities that follow are based. These activities include soil, stream and forest investigations; meteorology activities; and plant and animal studies. Each activity is described in detail and data collection field sheets are included. Language arts and mathematics activities encompassing environmental concepts are also described, and resource materials in these two disciplines are included. Other resource materials also included in this document are animal and plant identification charts listing characteristics of the specimen"s life habits as well as its physical nature. Some of the activity sections are divided into elementary and secondary level activities. This work was prepared under an ESEA Title III contract. A related document is ED 040 084. (JP)

ENVIRONMENTAL EDUCATION GRANT
FERNBANK SCIENCE CENTER
PROJECT SUMMARY

During the 1972-73 academic year, a program of assistance to outlying local school systems in the area of environmental education has been undertaken by Fernbank Science Center personnel under sponsorship of the U. S. Department of Health, Education, and Welfare. Briefly, the program has been one of identifying needs in the area of outdoor education curriculum design and resource utilization at the local level, then designing a program tailored to local needs and resources once these have been identified.

Following a survey of interest in and need for such a program of assistance, six school systems were selected for participation on a cooperative basis. Since local needs, desires, and resources differed somewhat in each instance, the individual programs of assistance likewise differed considerably in scope and direction.

With the exception of the one system (Bibb County) requiring only curricular assistance, all systems were provided with kits of equipment containing such items as a soil probe, rain gauge, wind meter, soil thermometer, magnifying glasses and other items useful in making environmental measurements or in studying various facets of the outdoors. Each system was likewise provided with a set of 2 x 2 transparencies covering the variety of habitat types (e.g. old field, forest, stream, etc.) encountered

in Georgia as well as local trees, wildflowers, fungi, reptiles, amphibians and birds.

The individual programs of assistance are described more fully in the following section:

INDIVIDUAL PROGRAMS OF ASSISTANCE

In general, most systems desired assistance in either setting up or furthering the evolution of outdoor education programs previously begun. In most instances this was accomplished by Fernbank personnel conducting a series of in-service workshops with teachers designated by the respective systems. In these sessions, activities at various grade levels were presented and the participants were provided with an activity-oriented set of teacher materials developed by Fernbank staff members.

FRANKLIN COUNTY: Franklin County, a rural northeastern Georgia county, required one of the more elaborate programs undertaken in the course of the project. Basically a dual program of assistance was devised involving elementary teachers in one aspect and junior high and high school personnel in the other. The elementary program involved three in-service training sessions of one to one and one-half hours duration and directly reached some seventy teachers. The types of programs and activities undertaken with elementary students at Fernbank were presented as models for the group's consideration in developing their own outdoor-oriented activities. The junior high/high school program, while directly reaching fewer teachers, was more elaborate. In

addition to a five session in-service program involving about fifteen teachers, a study trail 3/4 to 1 mile in length was laid out in a newly designated environmental study area adjacent to the junior high school. Plant identification markers, similar to the ones in use in Fernbank Forest, are being provided and will be set in place prior to the beginning of the next school year.

In addition to the formal on-site program undertaken, a "day-at-Fernbank" for the system's elementary teachers was held during the current year's post-planning session. During this activity, the Science Center's planetarium, observatory, meteorology and electron microscope laboratories, forest and other areas were demonstrated.

System and community enthusiasm for the project has been excellent with cooperative technical assistance provided by local Soil Conservation Service personnel and excellent publicity coverage on the project furnished by one local and two area newspapers.

COWETA COUNTY: Coweta County, a rural west Georgia county, was in excellent position to benefit from the environmental education program as they were in the final construction stages of a new junior high school adjacent to an excellent second-growth hardwoods area under school system control. This area was designated an environmental study area for the entire system so the teacher preparation program was centered on this site. Twenty-six teachers, grades one through junior high level in various subject areas, were designated by the system to form a pilot environmental education group. Representatives were chosen

from each of the system's schools in the hope that this might serve as one means of information dissemination among the professional educational community. Six on-site teacher in-service sessions, each one to one and one half hours in length, were held. In addition to the formal activity-oriented presentation, a study trail was laid out on the area, plant collections were made for a reference herbarium now in preparation, and trailside identification markers are presently being made and will be set in late August. Community support for the project is presently growing with labor for trail construction, etc., being furnished by local scout groups and municipal departments. Community awareness has been generated through local radio publicity.

DOUGLAS COUNTY: Douglas County, a traditionally rural community on the western edge of the metropolitan area, is rapidly undergoing urbanization. Consequently the rather forward-looking, innovative local school system has in the past few years been attempting to introduce several new approaches into curricula; among these have been various ideas related to environmental education. Many of the schools of the system, particularly the junior high schools, possessed environmental study areas in varying stages of development at the onset of the present program. However no formal attempt has been made in an effort to instruct classroom teachers in the use of these areas as an instructional resource. Five in-service sessions were held with approximately twenty-two teachers from various levels and disciplines. An administrative climate favorable to new approaches and directions contributed greatly to the program's success.

MARIETTA CITY: The Marietta City School System in nearby Cobb County was the single wholly urban system served in the present program. Their initial interest, though eventually system-wide, was for an outdoor-oriented program at a single elementary school serving a student body drawn primarily from a lower socio-economic group and largely nonconversant with the out-of-doors as an inquiry or learning resource. Three afternoon in-service sessions were held involving nineteen teachers, the principal and the system's Assistant Superintendent. By the program's completion, wishes were expressed for expanding the program to other schools in the system.

BIBB COUNTY: Bibb County, a large comprehensive school system serving the metropolitan Macon area, requested assistance of an entirely different nature than that required by any other system. In converting to a quarter system calendar with autonomous courses it was their desire to institute a comprehensive ecology course at the ninth grade level. Six teachers from the system were appointed to write the curriculum, with the system's Science Coordinator, a representative from the Macon Youth Museum, and the Staff Ecologist from Fernbank assisting. Considerable input was offered during the formative development of the curriculum; in addition, once completed, content, objectives and activities will be reviewed by Fernbank staff members for constructive suggestions.

CRAWFORD COUNTY: Although expressing an initial interest in the program, Crawford County, a rural middle Georgia community failed to follow through on plans for teacher involvement programs.

Repeated inquiries by both phone and letter failed to elicit any response of continued interest; consequently, with no local interest or support evident, Crawford County was dropped from the list of active program participants.

ADDITIONAL ACTIVITIES

In addition to the formal program offered in cooperation with participating school systems, other activities, integrally allied with outdoor education, have occupied a considerable amount of staff time during the program. One such activity was consultatio with representatives of the Cobb County Youth Museum regarding an activity based program on environmentally-oriented vocations. Another such outreach was participation of Fernbank personnel on an environmental education planning task force for schools located within Georgia's Ninth Congressional District (northeastern Georgia) This led directly to participation in a two-day environmental education program at the Unicoi Experimental Recreation Area involving students from Franklin County's Royston Elementary School and from Forsyth County High School.

OVERVIEW

Ultimate judgement on the success or lack of success in a program of this nature cannot, of course, be passed until the results of implementation begin to appear in local systems and students themselves are directly affected, hopefully beneficially. The effort directed toward success to this point has, however, been considerable. Since numerous personnel have been involved at various levels it is impossible to estimate the number of

man-hours expended. One hundred fifty-eight teachers have been reached and these in turn will directly influence approximately 5000 students yearly.

Physiographic Regions of Georgia

I. THE HIGHLANDS

The highland covers almost 2,000 square miles in the northeastern part of the state. Almost all of the area is mountainous, with elevations from about 2,000 feet to more than 4,000 feet. The highest peak is Brasstown Bald, elevation 4,768 feet. Headwaters of various rivers are found in the Highland (most of which have Indian names) and tend to run off in a northwest and a southeast direction. The Blue Ridge makes up about 2/3's or more of the Highland. Most of the Blue Ridge is over 3,000 feet in elevation and the crest line is irregular and broken into many peaked or rounded summits. The eastern half of this chain is higher than the western, in fact, east of Blood Mountain, near Vogel State Park, twenty-one of Georgia's peaks are 4,000 or more feet in height, whereas there are only six above that height to the westward.

Vegetation

The original climax forest of the Georgia Highland was part of the great Eastern Deciduous Forest Formation and was a mixture of hardwood with a preponderance of chestnut and various oaks. The effects of the chestnut blight, lumbering and fires have changed the forest physiognomy to a great extent. Chestnut sprouts and dead and decaying chestnut logs are still widespread over the forest floor, but the mature trees are rapidly being replaced by other species. Northern red oak, chestnut oak, scarlet oak, white oak, red maple, various hickories, tuliptree, and mountain magnolia (M. fraseri) are common over story trees in this region. Rhododendrons, mountain laurel, black locust, sassafras, serviceberry are common shrubs and understory trees. Coniferous trees include eastern white pine and eastern hemlock, two trees which, especially in moist coves and on north-facing slopes and in remote areas which have escaped lumbering, in association with broadleaf species make up a transition-type forest with characteristics suggestive of the Boreal Coniferous Forest Formation. Shortleaf pine and Virginia pine are often found on lower slopes where the soil is stony and thin.

Natural balds, or treeless summits are not infrequent. Some of these are grassy and some more or less covered with heaths or ericads. The problem of the origin of the balds has been subject to considerable debate.

II. THE LOOKOUT PLATEAU

The Lookout Plateau covers Dade County and small parts of Walker and Chattooga Counties in the northwestern corner of the state. Maximal elevations are approximately 2,400, 2,300, and 1,700 feet on Lookout, Pigeon, and Sand Mountains, respectively. This mesa-like region once belonged to a single vast peneplain whose surface had been eroded nearly to sea level. There followed many crystal uplifts, however, and some of the elevations that resulted were fully 2,000 feet above that "datum plain". The rock strata became bent, or folded rather like the surface of a great washboard, the shallow troughs being termed synclines, now aligned with the mountains themselves, and the alternating, up-folded strata termed anticlines, now replaced by valleys and coves. The more resistant sandstone which make up Lookout and neighboring mountains have been preserved. The topography is immature or submature.

Vegetation

Forests of oak, oak-pine or pine are scattered over the plateau surfaces, while more mesic associations, displaying a wide variety of broadleaf trees and shrubs, occupy the moister sites of gorges and slopes. White oak, chestnut oak, post oak, hickories, sourwood, persimmon, flowering dogwood, shortleaf pine and Virginia pine are found in the more xeric areas, with the pines dominating the ridges. American beech, American elm, tuliptree, sweetgum, American holly and eastern hemlock are partial to gorges and valley slopes. If the plateaus were more mature this mixed mesophytic forest, considered climax for the Cumberland Province, would prevail over greater area, at the expense of the oak-pine associations. The prevalent xeric communities of oaks, pines, and accessory trees represent a physiographic, edaphic and pyric climax, maintained by topography, sandy soil, and to some degree by fire.

III. THE APPALACHIAN VALLEY--(Ridge and Valley Province)

This is an extensive, elongate land-formation stretching from north central Alabama to New York. It covers, within Georgia, some nine counties and about 3,000 square miles. Its general elevation is 600-800 feet, roughly 1,000 to 2,000 feet below the adjacent mountain areas, Lookout Mountain and the Cohutta Range, which form its northwestern and northeastern boundaries, respectively. The Appalachian Valley is made up of broad valleys and numerous ridges, the ridges sometimes exceeding 1,500 feet. As to geologic age, the valley's rocks are older than those of the Lookout Plateau although not so ancient as those of the Highland. Through breakdown and decay, shales and particularly limestone, give rise to fertile, loamy soils, and the valley has some of the best farmland in the state.

Vegetation

The commonest trees of the general region are loblolly pine, shortleaf pine, post oak, southern red oak, blackjack oak, tuliptree, and sweetgum. Many other kinds of trees and shrubs are present. There is an increase southward in the abundance of loblolly pine, while longleaf pine, a species confined principally to the Coastal Plain, extends into Polk, Floyd, and Bartow counties, in the lower part of the Rome Valley. Cultivation and lumbering have destroyed most, if not all, of the original forests. The original forests were made up of oak-pine associations, with the pines, except on poorer and drier sites, being a subclimax to the oaks.

IV. THE PIEDMONT REGION--(Central Upland)

This region covers the greater part of northern Georgia and is bounded on the north and northwest by the Highland and the Appalachian Valley and by the Coastal Plain on the south and southeast. With an area of 18,000 square miles, it covers about 31% of the state. The Piedmont has a general elevation of somewhat less than 2,000 feet where it meets the Highland and drops to 500-700 feet along the Fall Line and the border of the Coastal Plain. It has fairly strong relief and is characterized by granite, gneiss and other crystalline rocks comparable in age to those of the Highland. It is divided into two sections, the Upper and the Lower Piedmont.

The Upper Piedmont boundary runs northeast and southwest and is formed through most of its course by the divide which separates the Chattahoochee River from the heads of southeastward-flowing streams. It passes from near Toccoa to the vicinity of Newnan and then westward in an ill-defined way. It is, in general, more elevated and has greater diversity of relief, including numbers of relatively isolated hills and small monadnocks than is the Lower Piedmont. The Atlanta Plateau is one of the divisions of the Upper Piedmont. Elevations around 1,000 to 1,200 feet are common. Mount Kennesaw, elevation 1,800 feet, and Stone Mountain, rising about 650 feet above the surrounding peneplain, are among the tallest of the hills of this region.

The Lower Piedmont has greater uniformity, lesser elevation and few monadnocks. It is bounded on the south and southeast by the Coastal Plain.

Vegetation

No virgin forest remains in the Georgia Piedmont. Stands of young and old growths of oak, hickory and associated trees together with cleared fields, early seral stages, culled stands

of hardwood, and less modified vegetation in places unsuited to cultivation, make up a mosaic or patchwork throughout the Piedmont. From this patchwork a reasonable picture of the original climax forest may be obtained. This forest is part of the Eastern Deciduous Forest Formation. Nearly all of Georgia was wooded in presettlement times; there were, however, "a number of glades and meadows". . . . mostly in the Piedmont, mentioned by Bartram and other early explorers. Important trees of present climax and near-climax communities in the Piedmont are white oak, hickories, post oak, black oak, scarlet oak, southern red oak, and northern red oak. Understory species include flowering dogwood, sourwood, red maple, black gum, red cedar, and sweetgum. On drier or poorer soils, post oak may be more abundant than white oak. Loblolly pine and shortleaf pine are far more prevalent in subclimax stands and along with Virginia pine in the northern Piedmont, are the first trees to invade abandoned, once-cultivated, upland clearings, commonly called "old fields". The pine forests which develop on such sites acquire a deciduous understory and are eventually replaced with oak or oak-hickory forming the more stable, self-perpetuating climax association. Because pines occupy large areas of the Piedmont of Georgia, the region's general vegetation may appropriately be regarded as an oak-pine association. In lowlands successional trees are sweetgum, tuliptree, sycamore, river birch, red maple, elms, ash, and hackberry.

V. THE COASTAL PLAIN

The Coastal Plain is mostly sandy and relatively flat, covering about 35,600 square miles or about 3/5 of the state. In Georgia it is bounded by the Piedmont to the north, the Chattahoochee River to the west, the Savannah River to the northeast, and the Atlantic Ocean to the east. Its northern edge, next to the Piedmont, is a ridge of sand hills, the "Fall Line", whose course is marked by the cities of Columbus, Macon, Milledgeville, and Augusta. This line formed an ancient ocean margin during the long period in which the Coastal Plain lay beneath the sea. In contrast to the Piedmont, which is built of crystalline rocks of Pre-Cambrian times, the Coastal Plain consists of water-deposited sand, clay, and limestone of more recent origin. Naturally occurring ponds, lakes, lime-sinks, all nonexistent in the Piedmont, accentuate the distinctiveness of the region below the "Fall Line". Swamps are commonly found in poorly drained areas, both upland and along streams; by far the largest and best known of these is the Okefenokee. Along the coast, sea beaches, sand dunes, and salt marshes provide other scenery peculiar to the region.

The Coastal Plain has been subdivided in several ways. It has been separated into Gulf and Atlantic portions based on drainage of the streams and rivers. It has also been divided in an Upper Coastal Plain and a Lower Coastal Plain based on physiographic studies, and on geology, vegetation and other natural resources. The geologically older, more elevated, interior half is flanked by the Piedmont along the Fall Line and by the Hazelhurst Terrace along its coastward margin. The Lower Piedmont includes marshes along the coast and the sea islands.

Vegetation

Although many of the same species of plants that are common in the Eastern Deciduous Forest Formation are present, near the coast the vegetation approaches the Subtropical Broadleaf Evergreen Forest which characterizes southern Florida. However, it is a narrowleaf--evergreen forest--a subclimax pineland--that makes up the most widespread vegetational type. Single-species dominance is manifest in the open stands of longleaf pine which tends to monopolize the landscape. Evergreens such as live oak and southern magnolia, as well as evergreen or persistent undershrubs are common. Bald cypress, pond cypress, swamp black gum, buttonbush, red maple, myrtle-leaved holly, sweet pepperbush, titi, fetterbush, water oak, sweetbay magnolia, red bay, pond pine, slash pine, and longleaf pine are some of the trees and shrubs that are common on the Coastal Plain. On the drier soils southern red oak, blackjack oak, dwarf post oak, turkey oak and bluejack oak.

A diversity of ecological habitats such as beaches and dunes, marshes, hammocks, and sandy oak-barrens as well as poorly drained roadside ditches allow the growth and development of many species of plants which are not found in the Piedmont and mountian regions.

Georgia Birds. Thomas D. Burleigh, University of Oklahoma, Press, 1968.

SOIL

Soil is formed by the action of sun, wind, rain, and freezing (WEATHERING) on underlying rock (PARENT MATERIAL). The process of soil formation generally takes thousands of years and is dependent upon the kinds of rock underlying an area. In general rocks formed by ancient seas (SEDIMENTARY ROCKS) break down more readily than more crystalline rock forms (IGNEOUS & METAMORPHIC ROCKS).

The soils of the Georgia Piedmont are among the oldest in the world and are mostly derived from rock types known as granites, schists, and gneiss.

As the soil-forming process proceeds, plants become established, die, and decompose forming a mat of decaying organic material on the surface of the mineral soil. Freshly fallen plant materials are consumed by soil animals--millipedes, centipedes, earthworms, mites, etc.--and excreted as a partially decomposed, gelatinous material known as HUMUS. This material is of spongy consistency and has great water-holding capability as well as the ability to hold much nutrient material (e.g. nitrate, phosphate, potassium) by growing plants. Bacteria in moist hardwood stands and principally fungi on drier pine sites act to further break the humus material down into such compounds as carbohydrates, proteins, and fats. Eventually these compounds are further degraded into carbon dioxide, water, and various mineral materials, a process known as MINERALIZATION. Newly fallen plant material is constantly being broken down and converted to humus at the upper soil surface while mineralization is constantly occurring at the underside of the organic mat. In relatively moist areas such as hardwood forests, breakdown by bacteria is fairly rapid and there is no great accumulation of fallen leaf material over several years. Pine needles, on the other hand, are more resistant to breakdown--and fungal breakdown is generally slower--with the result that fairly thick carpets of undecayed "pine straw" ofttimes accumulate in mature pinewoods.

Immediately beneath the organic layer other strata may sometimes be found. The uppermost of these, usually designated the "A" horizon, is a relatively dark narrow band characterized by the incorporation of organic particles from the overlying organic layer. This layer may or may not be present in our Piedmont soils--can you postulate some possible explanations for its absence? A somewhat lighter colored layer lies below the "A" horizon. Designated the "B" horizon it is the layer to which such materials as silicates, aluminum and other components of the clay minerals have percolated due to the repeated downwashing by rain water. A layer of more blocky or chunky structure--the "C" layer--lies further below. Underneath these strata of the SOIL PROFILE lies bedrock material not yet weathered.

SOIL

TEACHING ACTIVITIES

ELEMENTARY:

Soil Making:

Obtain some hand-size pieces of sandstone or limestone (or even bricks or chunks of concrete)--our more resistant granites and gneiss do not work as well--and allow the students to rub these briskly together over a sheet of paper. Notice how long it takes to "wear down" the rock material into "soil".

Soil Particles--are they the same size?

Obtain a "handful" of "good ole Georgia red clay" soil. Place it in a quart Mason jar (or 1 liter flask), fill the container with water, and stir or shake the contents briskly. Note that the larger, heavier particles (sand) settle out almost immediately after agitation ceases. In a few minutes another layer will have settled (silt). Many of the finest particles (the clay) will stay suspended for several days.

SOIL

TEACHING ACTIVITIES

JUNIOR HIGH/MIDDLE SCHOOL:

Effects of Weathering:

Obtain a small piece of limestone, heat it either over an open flame or on a hotplate, then immediately plunge it into ice-cold water. Result? (It should break readily.) What is responsible for this?

Rates of Decomposition:

Make several "litter bags" of nylon mesh, each about 12"x12". Obtain some freshly fallen leaves from a hardwood area, place these into the bags, weigh each bag and record its weight (carefully noting which bag is which by magic marker imprinted identification number or letter), then place the bags and contents back into the forest. Weigh at one-month intervals. If a pine area is available, a nice comparative study can be made by filling some bags with pine needles and placing them in the pinewoods. Compare the rate (speed) at which weight is lost with results from the hardwood area.

Effects of Plant Roots on Soil:

Obtain fist-size samples of soil from below a grassed crop field and a bare field. Immerse the soil samples in water. Results? Explanation?

SOIL

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THE FOREST

Forests are among the most interesting and complex biological communities. We are fortunate in the Piedmont region in having excellent forests of mixed composition available for study. Since most of our lands have been cleared at one time or another, most of our forests are second growth forests--that is, they are not the original natural vegetation although in composition they are generally similar to the kinds of trees present originally. On the Piedmont we can observe two general forest types--deciduous forests which lose their leaves in winter, and conifer forests which remain green throughout the year. Most of our deciduous woodlands are dominated by various oaks and hickories. Most of our pinewoods are dominated by the loblolly pine which has been introduced by man over the last 30 years as an important and commercially valuable crop. Eventually pinewoods, if left undisturbed, are overgrown by hardwood (deciduous) trees. This occurs due to SUCCESSION or the replacement of one biological community by another over a period of time. We can observe succession occurring around us if we look at a former crop field which has been abandoned. In the first year or two after cultivation the crop field is vegetated by "weeds"--annuals whose seeds are blown in or carried in by animals and which complete their entire life cycle--germination, growth, and fruit and seed formation--in a single season. If these plants recur in successive years they must grow from seeds just as they did initially (although the seeds might be more readily present since their "ancestors" occupied the land previously). As the annual plants die at the end of the growing season they eventually come to form an organic mat on the soil surface which--through the action of mites, centipedes, millipedes, etc. in the soil--serves to enrich the soil with organic matter which provides nutrients and increased water-holding capacity. With the increased fertility of the soil, perennial herbs--those weedy plants which die back at season's end but are capable of regenerating in successive years from rootstocks--invade the area. As the soil fertility and water-holding capabilities increase (due to the annual input of organic matter from dying weeds) scrubby hardwoods such as sumac begin to be found in the area as well as pines. These are trees which require full sunlight in order to survive; in 15 years or so our old field is usually a pinewoods. The litter (fallen needles, etc.) in the pinewoods is resistant to decay, and decomposition processes themselves are slow in the relatively dry site. As the branches of the closely spaced pines come to form an umbrella over the forest floor, the level of sunlight reaching the forest floor is decreased. Consequently young pines, which require almost full sunlight for development, are not too successful in growing to maturity while seedlings of the deciduous trees develop well in the reduced sunlight and more favorable soil moisture regimen is created by the buildup of much organic matter. Thus over a period of several years, new pines fail to be produced to replace those that gradually are lost, and the hardwoods come to occupy a dominant place in the community. In 100 years or so

the community will usually be completely dominated by deciduous trees, the decay/decomposition cycle will be more rapid (due to bacterial rather than fungal action), and the internal light level (and temperature) of the forest will be reduced.

Probably one of the more striking features of a well developed mature deciduous woodland is the STRATIFICATION or layering observed. The major trees constitute the CANOPY layer, an umbrella over the entire forest; it may be 70-125 feet high. Somewhat lower (about 30 feet) another group of trees--either immature individuals of those species which form the canopy or generally smaller trees such as dogwood--form the SUBCANOPY. Nearer the ground (between 1-6 feet) occurs the SHRUB layer and below 1 foot the HERB layer. Each of these layers ofttimes has specific animals (insects, birds, etc.) associated with it.

FOREST

TEACHING ACTIVITIES

JUNIOR HIGH/MIDDLE SCHOOL:

What is a forest?

Allow class members to sit quietly in the midst of a woodland and merely observe. After a few minutes, allow them to express their impressions. What is the most striking feature? (trees, perhaps?) How does the temperature compare with open land around the forest margin? (This may lead to actual measurements in each area.) What about light levels? What sounds are heard? Are animals, other than birds and insects, obvious? Why are the typical forest mammals such as shrews, mice, voles, etc., not more prominent? (Most are active at night.) Turn over the organic litter (leaves, needles, etc.) covering the ground. Notice the whitish patches of fungi which act to decompose the dead leaves, etc., and make their materials available for re-use by the forest.

What will this forest be like in a few years?

Measure a plot, say 50' x 50' and allow the students to count the mature oaks, hickorys, poplars, etc. (It is not necessary that they be able to identify species--noting composition by noting similarities in leaf shape is sufficient.) Calculate the percentage of each species as a percent of the total number of trees in the plot. Now count the number and kinds of seedlings on a portion of the plot (Remember if 1/10 of the plot is counted to multiply the end result by 10, etc.) and obtain percentages of each kind of seedling as a percent of the total number. If all the seedlings mature (in all likelihood, they won't) will the composition of trees in the forest in many years be similar to what it is now or different?

How many trees are in the forest?

Stand density is the number of trees present per some unit of measurement (acre, square feet, etc). A simple, rapid and relatively accurate estimate may be made by allowing students to walk a straight line 100 feet or more in length with arms outstretched and count all trees (disregard those less than 4 inches in diameter--or "less than ankle diameter"). The number of trees per acre may then be calculated by the relationship:

$$\frac{\text{distance walked in feet} \times \text{width of outstretched arms in feet}}{\text{43,560 sq. ft. in acre}} = \frac{\text{number of trees counted}}{\text{number of trees per acre}}$$

In a mature hardwood forest 200 (plus or minus 25) trees per acre which are greater than 4 inches in diameter is "average". Younger stands and pinewoods will tend to have more than 200 trees per acre.

Several other excellant forest-oriented activities--including methods for estimating the amount of merchantable timber in a forest--can be found in the section "Math Activities for the Outdoors".

FOREST

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STREAMS

Streams are fascinating from many aspects--their beauty and aesthetic properties, their physical aspects, and their resident biological "critters". Probably in no other habitat type can art, communication skills, and the sciences be interwoven to such an extent as in the study of streams.

Children (and adults) of all ages are usually fascinated by flowing water and the very sounds of the stream itself speak a kind of poetry to the often harried modern citizen.

Streams, simply put, are systems of moving or flowing water. They have a SOURCE, usually either a lake or pond where surface water has accumulated or a spring where the subsurface water table touches ground level.

Streams are constantly cutting their way to (or even through) the bedrock underlying an area. Along the outside of their long sweeping curves they tend to cut or erode stream banks and deposit the fill along the inside of curves and in areas of slower flow. Streams vary greatly in the volumes of water which they carry (and this varies in a given stream with regard to rainfall, etc.) and the velocity (speed) at which they flow. Coupled with these factors of stream volume and velocity are the bottom materials found in the stream. Probably the stream bottom, more so than any other single factor, determines the biological inhabitants of the stream. In the relatively slow flowing streams of our Piedmont area most streams have a bottom of sandy material. Stream bottoms in the mountains and fall line region--where greater grades and velocities are common--are normally covered by gravel, rocks, and even boulders in the case of larger streams.

A stream provides a wealth of diverse habitats for plant and animal life. In fast flowing waters (riffle areas) algae tend to cover the rocks and immature insects (stoneflies, Mayflies, caddisflies, etc.) are found underneath stones, etc. In quieter pool areas, liverworts and mosses may cover the emergent portions of rocks and the animal life may include striders on the water surface, various kinds of aquatic beetles, and various worm forms on or in the bottom. Of course a multitude of microscopic forms (single celled algae and protozoa, small crustaceans, etc.) are present in each drop of water. Bacteria and water-borne fungi may also be present. Crayfish may frequent the pool areas and the backboned animals (vertebrates) are best represented by the fishes (as well as the amphibians--frogs and salamanders that are frequently found in or near water).

STREAMS

STUDY ACTIVITIES

Animal Life in Streams:

First allow the students to observe the stream bottom--this is the key to the kinds of "critters" to be found. If both sandy-bottom and gravel-bottom areas are available an excellent comparison of the kinds of animals in each can be made.

In gravel-bottom or rock-bottom zones many of the stream inhabitants (mostly immature insect forms and various "worms") will be found clinging to the underside of the stones. These can be collected easily by having one student hold a dip net downstream from the area under study while other students carefully pick up the bottom materials (rocks, etc.) and "wash" them in the mouth of the open net. The exercise can be made quantitative by measuring a specific area to be sampled--say 1 square foot--marking the corners of this area with wire stake marker flags, then carefully washing all the bottom material within this area. Once collected the animals can be "backwashed" from the collecting net into a shallow enamelware or aluminum pan for observation or sorting. Probably it is best to return the animals to the stream after the students have had an opportunity to see them; however, if later class study is desired 70% ethyl alcohol is a suitable preservative.

In slower flowing or sandy-bottom zones a similar collection technique may be applied but it will probably be necessary to "grovel" in the sand for several inches and "wash" this material through the net. Minnows and larger aquatic life may be taken by dip netting in shaded areas under overhanging vegetation or in areas where the banks overhang the stream channel.

Killing/Preservation Techniques:

1) Small crustaceans, hydra, and insect larva (except hard-bodied ones such as bugs and beetles): a) Put animals in a solution of a small amount of water and 40% formalin, b) Let stand for 2 to 3 hours, c) Preserve in 70% ethyl alcohol.

2) Hard-bodied bugs and beetles: a) Put in boiling water for 1 minute, b) Let cool, c) Preserve in 70% ethyl alcohol.

3) Worms, flatworms, and leeches: a) Relax them by placing in a flat dish with a small amount of water. Add a 5% solution of magnesium chloride until they stop moving; b) Place flatworms in a solution of 6 parts 90% ethyl alcohol; 3 parts 40% formalin and 1 part ethyl acetate for 24 hours; c) Preserve in 70% ethyl alcohol; d) Place worms and leeches in a solution of 93 parts distilled water, 2 parts concentrated nitric acid and 5 parts 40% formalin; e) Preserve in 70% ethyl alcohol.

4) Snails and clams: a) Put in boiling water for 1 minute; b) Let cool; c) Preserve in 10% formalin (1 part formalin to 9 parts water).

Plant Life in Streams:

Allow the students to look for obvious plants in various portions of the stream. Are plants more evident in slow-flowing or fast moving portions of the stream?

In slow moving portions of a stream plants can often be observed in different zones: 1) The Shoreline Plant Zone--ground is usually wet; 2) The Emergent Plant Zone--Plants are rooted in the mud but extend above the water surface into the air. When the water level is low these plants may become the shoreline plants; 3) The Floating Plant Zone--Plants may or may not be rooted but part of the plant floats on the surface; 4) The Submerged Plant Zone--Plants are rooted and do not extend above the water surface.

Usually the line between any two zones is not sharp and plants of one "zone" may be found interspersed among those of another zone.

Without it being necessary to know specific plant names, the number of kinds of plants in each habitat type can be noted quickly and easily. Which kinds are most numerous in your stream?

How Fast is the Stream Flowing and How Much Water Is It Carrying?

Instructions for measuring streamflow:

1. Field Study

   Instructions for collecting and recording streamflow measurements:
   a. Measure and mark with stakes a 100 foot distance along a straight section of your stream.
   b. Find how fast the stream is flowing. Throw a stick (2 or 3 inches long) in the water above the upstream marker. Record the number of seconds it takes to

float between the markers. Record below. No. of seconds to float between stakes: _____ seconds. Now divide the 100 foot distance by the total seconds it took the stick to float between the stakes. This will tell you how many feet the stick floated each second.

100 ft. (distance) ÷ _____ (total seconds) = _____ ft. per sec. (number of feet stick floated each second)

c. Find the average width of the section of the stream. Measure the width of the stream at 3 places within the 100 foot area. Record the measurements below. Divide the total by 3 to get the average width of the stream.

First measurement _____ feet

Second measurement _____ feet

Third measurement _____ feet

Total _____ feet ÷ 3 = _____ ft. (average width)

d. Find the average depth of the section of the stream. Wade across the stream in a straight line. Measure the depth of the stream in 3 places along the straight line. Record measurements below. Divide the total by 3 to get the average depth of the stream.

First measurement _____ feet

Second measurement _____ feet

Third measurement _____ feet

Total _____ feet ÷ 3 = _____ ft. (average depth)

e. Find the cubic feet of water per second. Multiply the average depth and the number of feet the stick floated each second. This will tell you the number of cubic feet of water flowing in the stream every second.

_____ (average width) x _____ (average depth) x _____ (Number of feet per second) = _____ (cubic ft. of water flowing per second)

Note: A cubic foot of water is the water in a container 1 foot wide, 1 foot high and 1 foot long.

2. Conclusions

Use this table of water measurements to answer the question below:

TABLE OF WATER MEASUREMENTS

A Water Flow of 1 Cubic Foot Per Second = 448.83 Gallons Per Minute	
One cubic foot of water	= 7.48 gallons
One cubic foot of water	= 62.4 pounds

a. How many gallons of water flow is in this stream every second?

(Stream flow in cu. ft. per sec.) x (7.48 gallons in 1 cu. ft. of water) = (gallons of water per second)

b. How many gallons of water flow is in this stream every minute?

(Gallons per second) x (60 Sec. in minute) = (gallons of water per minute)

c. Each person uses about 150 gallons of water a day. What is the total number of people who could live from the water in this stream?

(Gallons of water per minute) x (no. minutes in a day) = (Total gallons water per day) ÷ (Amount of water one person uses per day) = (Total no. people who could live from water in this stream)

STREAM

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METEOROLOGY

Although primarily confined to a ten mile shell of atmosphere around the Earth, weather more directly influences man's activities than any other concern. It is a rare day that we fail to consider the weather's influence on our activities: "do I need a sweater;" "should I turn on the air conditioner;" or "should I cover the plants."

As prisoners of gravity, we live nearly our entire lives on the surface of the Earth. Meteorologically this is a most interesting and variable area. Almost all the energy which Earth receives from the sun is absorbed at the ground; consequently, extremes in temperature are found where we live. We may "bake" while standing in the sun on a blacktop highway, but over a snow covered field during a clear night we might "freeze" to death.

Weather is the result of differences or changes in the atmosphere. It is the role of the Meteorologist to explore and attempt to explain these perplexing changes.

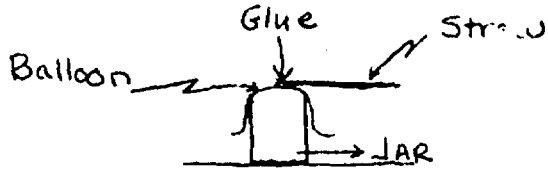
Note 2: Because our thermometer works by expansion of air with heat rather than the usual mercury, with cold temperatures the colored water will be high and with warm temperatures the water will be low. Discussion of this difference will help students understand expansion and contraction and the thermometer more thoroughly.

2) Air Pressure - the Barometer

Materials:

1 small jelly jar
1 medium sized balloon
1 rubber band
1 lollipop stick or straw
Tape or glue and cardboard

Diagram:



Procedure:

Stretch balloon over jar and secure it with rubber band
Glue stick to center of balloon
Place cardboard (to be used as scale) behind straw
For several days mark the position of the pointer on the cardboard with the corresponding pressure determined from television weather shows, the weather bureau or a class barometer.
You will find high pressure (fair weather usually) pushes the balloon in and makes the pointer rise. For low pressures (stormy weather), the opposite will occur

3) Rainfall - the Rain Gauge

Materials:

1 coffee can
1 narrow olive jar
Strip of Paper
Tape
1 funnel (optional)
1 ruler

Activities:

Elementary and Middle

A. Weather Instrument Construction

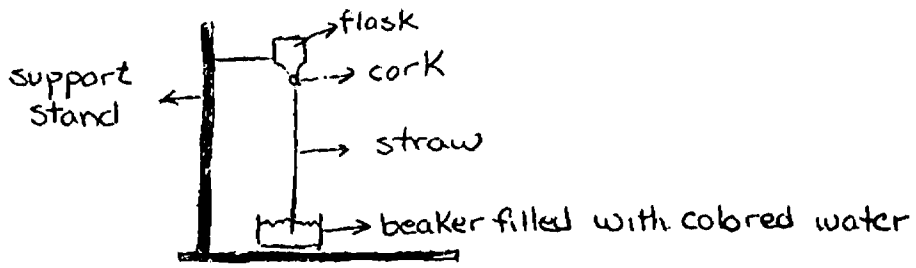
An activity to help students understand the basic physical principles involved in weather instruments. It serves to introduce students to basic elements of meteorology such as temperature (heat), air pressure, and rainfall.

1) Temperature - the thermometer

Materials:

1 jar or flask with fitting one-holed cork
1 glass tube or plastic straw fit snugly into cork
1 thermometer
1 small beaker or jar
1 support stand
water, cardboard and food color

Diagram:



Procedure:

Assemble materials as illustrated
Heat the flask with matches (1 or 2); air in the flask will expand and bubble out the bottom of the tube
Allow the flask to cool; the colored water will rise up the tube, because as air cools it contracts into the flask and the water rises to replace it. When the liquid stops rising, place a piece of cardboard behind the tube and mark on it the level of the liquid. With the thermometer determine the room's temperature and place that number by the mark
Put the home-made thermometer in a refrigerator; let the liquid come to a new level and make a mark with the refrigerator's temperature written next to it.
With a ruler make marks on the cardboard at equal distances from one another. These marks will help complete the thermometer scale.

Note 1: Since water is used, this thermometer will not work at temperatures below freezing (32° F).

Procedure:

Cut tops off the five cups about 1 and 1/2 inches from bottom. Save both tops and bottoms.

Fill one cup with water, one with dry sand, one with dry charcoal, one with wet charcoal.

Arrange cups in circle.

Place thermometer to depth of no more than 1/8 inch in each cup.

Hang light bulb about 12 inches above the center of the circle of containers.

Record beginning temperature in each cup.

Record the following information and later graph temperature versus time for each soil.

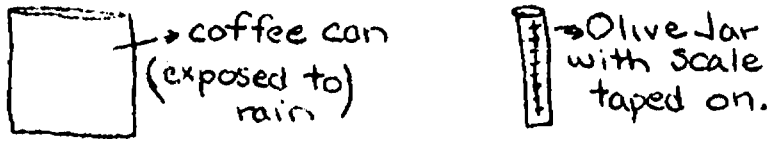
Temperature Reading

	Light Off	Light On			Light Off
		After 1 min.	3 min.	5 min.	After 5 min. cooling
Water					
Dry Sand					
Wet Sand					
Dry Charcoal					
Wet Charcoal					

2) Outdoor Observations

a) observe temperatures at different locations at same time
b) observe daily maximum and minimum temperatures at different locations
c) follow up this study with an analysis of possible explanations for the observed differences. Relate to soil temperature experiment as well as other possible effects
d) Summarize these in the form of a final report. If short enough, consider copying it for each student and filing it in the school and community libraries as reference materials

Diagram:



Procedure:

Fill coffee can with exactly one inch of water.
Pour into olive jar. At the level of the water, make a mark. Label it 1 inch.
Divide the scale into ten equally spaced marks labelled 0.1", 0.2", ..., 0.9", 1 inch.
After rain has fallen in coffee can pour it into olive jar. An accurate value for the amount of rain can then be determined.

Elementary

A) Keep a daily chart of the weather including temperature, pressure, wind speed and direction, clouds and precipitation.

B) Draw pictures of different clouds and note what kind of weather they bring.

C) Discuss what happens to the rain water after it falls.

Middle School/Junior High

A. Earth Surfaces and Air Temperature

Because air absorbs little heat energy directly from the sun and most of its energy by contact with the ground, air temperature is directly related to the character of the surface it touches.

1) Soil Temperature Experiment

Materials:

5 styrofoam cups
5 thermometers
Scissors
1 150-watt light bulb
water at room temperature
dry sand
finely crushed charcoal

B. Weather Record

In order to get a better understanding about the weather, the student must do more than just read about it; he must observe it.

1) Observations

maximum-minimum thermometer
barometer
cloud chart
rain gauge
hygrometer
beaufort wind chart or anemometer

Procedure:

Have each student or group of students keep record of the weather for a minimum of 4 weeks. Distribute assigned observation times so that one group makes morning, another makes noon and a third makes afternoon readings.

Weather-Chart

Date						
Time						
Temperature						
Wind direction						
Wind Speed						
Cloud type						
Cloud cover						
Precipitation type						
Pressure						
Humidity						

C. Weather Maps

Cut out daily weather map from newspaper and compare it to the observations.

Note cloud types. What clouds precede warm fronts? cold fronts? What clouds do rains fall from? What clouds accompany fair weather? If there is an interested photographer among the students, have him keep a pictorial record of these clouds for future reference.

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ACTIVITIES FOR THE PRIMARY GRADES

1. Weaving Sounds into a Story - Make a list of all the sounds heard during an outdoor education experience, giving the sources of the sounds. Use the list as the basis for a story. Let each child select one source and imitate its sound each time that object is mentioned in the story.

2. Seeing Likenesses - Use the child's interest in pretty leaves to help him gain readiness for reading. Match leaves of different colors or notice likenesses and differences in shapes. Later matching may include two things to think about - a large or small leaf that looks like a certain one of opposite size.

3. Reference Skills - Primary children can use a book in which flowers are pictured. By finding the page and comparing the picture with the real flower the identity of the flower can be determined although the reading of the name may have to come from the teacher.

4. Prepare a Booklet to Review a Season - The class might write and perhaps illustrate a booklet giving their concept of the sights, sounds, smells, tastes, and other sensations of the particular time of year.

5. Investigation Map-Making Skills - Soon after the children have begun the study of maps, let each one, working outdoors, make a rough sketch map of the school grounds, or part of the grounds, to see what ideas about maps have been acquired. Older children might sketch a map of the area showing how each is similar to forests, prairies, arid land, cultivated land, moist lands, and other special regions. Compasses may also be used.

6. Studying a Tree-Stump Record - Find a stump of a tree recently cut and count the annual rings. Children ejoy seeing how big the tree was when they were born. Historical events can be linked to the age of the tree also.

7. Note the Influence of Environment of People's Way of Life - Talk with the class about the fact that people's natural environment has a great influence on their way of life. Then start a discussion of how the local area has influenced each child's life that day. Have the children consider questions such as the following:
   Why did you dress as you did today and what part did the local climate have in your choice of clothing?
   Why is the region you live in a city area?
   What are the main products of the region where you live? Why?

What are the principal occupations of the people in your region? Why?
How do the main products and the principal occupations of your region affect the interests and activities of the people in your region?
What is one region in the United States that you consider to be greatly different in natural environment from your own area? How does the way of life there differ from your own? Why?

8. Comparing Insect Activities with Human Occupations - When the group has become familiar with the skills and habits of insects, it would be interesting to compare insect activities with some human occupations. Ask such questions as: What insects would be diggers of tunnels? (Corn borers, bark beetles, termites) Can you name some masons? (Mud-daubers) What insects would be paper-makers? (Paper wasps, hornets) Attention might be called to sea captains (water striders), tent makers (tent caterpillars), scavengers (carrion beetles), acrobats (click beetles), carnival workers (whirligig beetles), and Musicians (cicadas, katydids, and crickets.)

9. Comparing Man's Inventions with Nature's Devices - Look in the outdoors for devices of plants or animals that parallel man's inventions or devices. Then compare Nature's ways with those that man has developed. For example, what insect uses fans for cooling? (Bees use their wings to cool the hive.) What plants use better packing methods than the canners of sardines? (Investigate seed pods such as those of Milkweed) What animals wear goggles? (Study frog's eyes.) How does a dragonfly nymph use jet propulsion?

10. Math activities - Collect acorn counters to be used in number work. Make a display of leaves to represent numbers. Use the thermometer in comparison to the number line. This also helps understand change and difference. Take a tree census. Make graphs of data collected. Count populations of insects or birds or trees. Relate this to populations of men.

11. Discovering Shape and Form - Look at natural objects. Which leaves are egg-shaped, and which are heart-shaped? How many triangles can you find in seed pods? What shapes are found in honeycombs? in flowers? in snowflakes? Have you noticed that the edge of an acorn cap forms a circle? Have you looked at the stems of the mint family? (four sided)

12. Observe colors - Paint a cloud.

Projects: Make a terrarium. Prepare a spider web print. Make musical instruments. Make spatter or sand prints.

COMMUNICATION THROUGH OBSERVATION

I. Lead-up Activity:

Have the students write a description of something they might find in the woods such as a tree, flower, etc. in as much detail as they can recall.

Outdoor Activity:

Take the class outside and have them examine what they had described. Remind them to use all the different senses that are appropriate for their object. Have them write a new description as they are there observing the object.

Follow-up Activity:

The students can compare the two descriptions of the same object to determine how much greater detail they had when they took the time to observe.

II. Lead-up Activity:

Using newspaper articles, have the students find the major parts of the first paragraph: who, what, when, where, why and how. Discuss with the students why these major factors constitute a concise means of taking field notes and reporting accurately.

Outdoor Activity:

While in the woods have the students look for events to report such as "Ants Protect Home from Invaders", "Robin Attacks Worm", "Squirrels Open Branch Office", or "Leaves Turning Brown". Remind students to take accurate notes in the field.

Follow-up Activity:

From the notes taken in the field have each student write a newspaper article or give a news report.

Figures of Speech

1. Metaphor - one thing is likened to another different thing by being spoken of as if it were that other thing.

   i.e. The rotten log is a hotel.

   The fungus is a garbage man.

2. Personification - a thing, quality, or idea is represented as a person.

   i.e. The tree had a nest in her hair.

3. Simile - one thing is likened to another dissimilar thing by the use of "like" or "as".

   i.e. Clouds are as soft as pillows.

4. Hyperbole - exaggeration for effect not meant to be taken literally.

   i.e. The tree is as old as time.

5. Onomatopoeia - the formation of a word by imitating the natural sound associated with the object or action involved.

   i.e. The bee buzzed around our heads.

Certain figures of speech may be taught effectively in the out-of-doors. Before the group starts, they must be prepared through the use of the five senses. After they have listened, smelled, touched, observed, and in some instances tasted, they will be ready to begin.

Go outside and find objects in your environment that are representative of the following pairs of words:

hard/soft	justice/injustice
ugly/beautiful	want/need
big/small	eater/eaten
like/dislike	threatening/calming

Students can choose pairs of words of their own and find things to represent them.

Use outdoor experiences to help children to become interested in finding the exact words needed to convey a certain meaning. Let children suggest words that describe an event, feeling or object or action.

i.e. Was a forest - still, hushed, motionless, silent, serene?

Were a chipmunk's movements - rapid, agile, nimble?

Have children use lists as basis for discoveries of natural objects to which adjectives (or adverbs) would apply.

i.e. soft - moss, dandelion, steps of an ant

sharp - pointed grass, thorn, bluejay's scream

rustling - brook, leaves, wind

After listening to various sounds of the forest, help children use original combinations of words to describe a certain bird's call, the hum of a bee, etc.

Using reference books and materials:

"Living Labels" - After using reference material for research, each child might be a living label for a tree, an animal or another object to be stationed near it in the forest to give information orally. Another class, as guests, could be divided into small groups to go on the "tour".

Field Guides - The students could learn to use field guides for the identification of trees, birds, reptiles, etc.

An Outdoor Experience As A Basis For Myths

III. Lead-up Activity:

Read ancient Greek and Roman myths and myths of other countries. Discuss the fact that these were often created to explain natural phenomena. Two examples of myths have been provided.

Outdoor Activity:

On a walk through the woods, have the students find natural phenomena that they could write an explanation for in the form of a myth. These may be from their own standpoint or from the viewpoint of something else in nature, such as an ant explaining the huge growth of a mushroom.

Follow-up Activity:

Have the students tell their story to the class the way an old story teller would. Make a collection of the stories.

The same type of activity could be done using fables, tall tales, etc.

Legend of the Narcissus

The narcissus family includes the daffodils and jonquils, so one can never be quite certain to which flower the Greek legend of the tragic youth called "Narcissus" pertains.

Narcissus was a handsome young man, beloved by all the woodland nymphs. But he had no time for any of them, not even for the fairest, pensive Echo. Echo did everything she could to attract him, but she had met with disfavor of Hera, jealous wife of Zeus, who had forbidden her to use her tongue except to repeat what had been said to her. Yet she sought Narcissus and one day saw him in the woods. "Is anyone here?" the young man called. And the joyful Echo answered, "Here!" "Here!", "Come", he called. "Come!" she answered, stepping out to meet him, her arms outstretched. But Narcissus had no interest in her. All Echo could do was to mourn. Narcissus was gone and the heart-sick nymph left the woodland paradise to roam throughout the rocky plains of earth and all that is left of her is her voice.

Narcissus could not go on spurning the nymphs forever. They appealed to the terrible goddess Nemesis, the righteous avenger. Determined that Narcissus should experience the sorrow of an impossible love, Nemesis made him enchanted with his own reflection as he leaned over a pool to drink. And there he remained, gazing into the water day after day, unable to leave the beauty of his own image, even for food. His body grew weak and he died.

Legend of the Narcissus
(Continued)

The next day his body disappeared, and in its place was a narcissus (or perhaps a daffodil or jonquil) bending its head over the pool, still entranced with its watery image. And even today, the plants of the narcissus family love the shaded, moist woodlands close to a quiet pond or creek.

Why the Woodpecker Has a Long Beak

(Romania)

Know that the woodpecker was originally not a bird, but an old woman with a very long nose, which she put into everybody's pots and pans, sniffing about, eavesdropping, inquisitive, and curious about everything whether it belonged to her or not, adding a little in her tale-bearing and takingoff a bit from another tale, and so making mischief among her neighbors. When God saw her doings, he took a huge sack and filled it with midges, beetles, ants, and all kinds of insects and tying it tightly, gave it to the old woman and said to her: "Now you take this sack and carry it home, but beware of opening it, for if your curiosity makes you put your nose into it, you will find more than you care for, and you will have trouble without end".

"Heaven forbid," replied the old hag, "that I should do such a thing. I am not going against the will of God. I shall be careful."

So she took the sack on her back and started trotting home, but whilst she was carrying it her fingers were already twitching and she could scarcely restrain herself, so no sooner did she find herself a short distance away than she sat down in a meadow and opened the sack. That was just what the insects wanted, for no sooner did she open it than they started scrambling out and scampered about the place, each one running his own way as fast as its little legs would carry it. Some hid themselves in the earth, others scrambled under

the grass, others, again, went up the trees, and all ran as fast as they could.

When the old woman saw what had happened, she got mightily frightened, and tried to gather the insects to pack them up again. But the insects did not wait for her. They knew what to do, and a good number escaped. Some she was able to catch, and these she packed into the sack and tied up. Then came a voice asking her what she had done and if she had kept her promise.

"Where are the insects which I gave you to carry? From this moment you shall change into a bird and go about picking up all these insects until you get my sack full again." And so she changed into a woodpecker; the long beak is the long nose of the old woman, and she goes about hunting for the insects in the hope of filling up the sack. To this day she has not completed her task and has remained a woodpecker.

A Fable: The Grasshopper and the Ant

(Aesop)

One summer day a grasshopper met an ant. The ant was working hard laying up food for the winter. "Why do you work so hard?" said the grasshopper. "Why do you not sing as I do and enjoy the beautiful summer days?" But the ant did not reply. He kept on working, and the grasshopper kept on singing and enjoying the beautiful summer.

When the winter came and the rains washed away the food of the land, the grasshopper was hungry. He went to the ant and said, "Give me some food, for I am hungry." But the ant said, "You should have worked in the summer as I did, putting by for the winter time. But you wanted to sing instead. Now you may eat your song."

This story teaches us that we must labor and save in times of plenty if we wish to have what we need in times of want and distress.

Poetry

I. Contemporary French

Take the class out and have each student select his own area, separated from each other as far as practical. Have them list as many things as they can sense, using descriptive words and/or short phrases.

Using a contemporary French form of 5 line poetry, consisting of 5 words in the first line and decreasing each line by one word, have the students put together words that are pleasing to them and that describe their experiences outside.

i.e. Little rocks smaller than raindrops
Rain on light plastic
Small drum beats
Swamp wet
Swish

II. Symtu - Japanese verse of 5 lines

Line 1 - one word naming something.

Line 2 - a line expressing a feeling or emotion about the first word.

Line 3 - a physical description of the thing.

Line 4 - another feeling or emotion.

Line 5 - a one-word synonym of line 1.

i.e. Leaves
A sign of Winter
Blanket for earth's forests
Place called home
Litter

III. Japanese Haiku

Haiku is a three-line, seventeen-syllable poetic form that paints a verbal picture of an experience. A good haiku is hard to write because the poet must combine acute perception, creative use of words and a framework for the reader to relive an experience based on a few suggestive phrases. Often the poet relies heavily on his senses to convey his reactions.

The words at the end of the line do not need to rhyme. The first line has five syllables, the second line has seven and the third line has five.

Japanese Haiku

Whirling wind drops in,
Gives a message of the wild,
Then passes away

Soft silhouetted
Bare branches cushioned
by clouds
Fired by setting sun

Standing on a hill
A wind comes to visit me
Pushing leaves ahead

Long-forgotten thing:
a pot where now flowers bloom
thus now day of spring!

The willows hanging low
shake from their long, trailing skirts
the freshly fallen snow

The winds that blow
ask them, which leaf on the
tree
will be next to go.

Dear Ranger Rick

P. O. Box 2299

Philadelphia, Pa. 19103

THE TANKA GAME

I read about a game Japanese children play at parties. They choose sides and each child on one side makes a haiku. Then each one on the other side has to add two lines to make a "tanka".

First I will tell you how to make a haiku, in case you don't know. A haiku is a poem that doesn't rhyme. It tells something you think or feel about nature. It has five "claps" (beats or syllables) in the first line, seven in the second line and five in the third line.

A tanka adds two more lines to continue your thought. Each of these lines has seven "claps".

Both kinds of poems have been made for hundreds of years in Japan. Now American children have found out what fun they are. I think this is good because sometimes when children write poetry we say silly things just to make the rhyme come out right. With the haiku and tanka we can say what we really feel. But we still have to shape the words to a certain rhythm. The rhythm gives our thoughts a jewel-like form. The words we choose can make the little poems sparkle or softly glow.

I began writing haiku when I was seven. Later I made some of them into tankas.

Here is one about my cat, Sullivan:

I try to hold you
But you run away from me,
My lap is too small.
When I grow a bigger lap
Will you be the same sized cat?

Here is a haiku about mustangs. Would you like to make it into a tanka?

Galloping horses
Hide yourself in desert dust
Before men catch you.

A friend mailed this haiku to me. She asked me to make a tanka out of it. She wrote:

Seagulls go flying
Over the white-capped ocean
And I am dreaming.

I added:

That I too fly high and low
Enjoying the bright big world.

Also, I added:

Of things coming to my life
I think and wonder and hope.

My friend likedthe first one best. Do you? Or would you like to write something quite different? Try it. It's really fun.

D'Jemil Quinones

Using an Outdoor Setting for a Story or Poem

Much can be said for reading or telling or listening to a story or poem in an atmosphere that sets a mood for it. The listener is the pioneer or Indian of the story when he listens to it read or told to him in the shade of the trees in the forest.

For example, a Longfellow Lab could be held outside reading "Hiawatha" or the "Courtship of Miles Standish".

> Then upon one knee uprising,
> Hiawatha aimed an arrow;
> Scarce a twig moved with his motion,
> Scarce a leaf was stirred or rustled,
> But the wary roebuck started,
> Stamped with all his hoofs together,
> Listened with one foot uplifted,
> Leaped as if to meet the arrow,
> Like a wasp it buzzed and stung him!

Departmental

Robert Frost

An ant on the tablecloth
Ran into a dormant moth
Of many times his size.
He showed not the least surprise.
His business wasn't with such.
He gave it scarcely a touch,
And was off on his duty run.
Yet if he encountered one
Of the hive's enquiry squad
Whose work is to find out God
And the nature of time and space,
He would put him onto the case.
Ants are a curious race;
One crossing the hurried tread
The body of one of their dead
Isn't given a moment's arrest-
Seems not even impressed.
But he no doubt reports to any
With whom he crosses antennae,
And they no doubt report
To the higher up at court.
Then word goes forth in Formic:
"Death's come to Jerry McCormic,
Our selfless forager Jerry.
With the special Janizary
Whose office it is to bury
The dead of the commissary
Go bring him home to his people.
Lay him in state on a sepal.
Wrap him for shroud in a petal.
Embalm him with ichor of nettle.
This is the word of your queen."
And presently on the scene
Appears a solemn mortician;
And taking formal position
With feelers calmly at widdle.

Seizes the dead by the middle,
And heaving him high in air,
Carries him out of there.
No one stands round to stare.
It is nobody else's affair.

It couldn't be called ungentle.
But how thoroughly departmental.

The Road Not Taken

Robert Frost

Two roads diverged in a yellow wood,
And sorry I could not travel both
And be one traveler, long I stood
And looked down one as far as I could
To where it bent in the undergrowth;

Then took the other, as just as fair,
And having perhaps the better claim
Because it was grassy and wanted wear;
Though as for that, the passing there
Had worn them really about the same.

And both that morning equally lay
In leaves no step had trodden black.
Oh! I kept the first for another day!
Yet knowing how way leads on to way,
I doubted if I should ever come back.

I shall be telling this with a sigh
Somewhere ages and ages hence:
Two roads diverged in a wood, and I -
I took the one less traveled by,
And that has made all the difference.

Stopping By Woods on a Snowy Evening

Robert Frost

Whose woods these are I think I know.
His house is in the village though:
He will not see me stopping here
To watch his woods fill up with snow.

My little horse must think it queer
To stop without a farmhouse near
Between the woods and frozen lake
The darkest evening of the year.

He gives his harness bell a shake
To ask if there is some mistake.
The only other sound's the sweep
Of easy wind and downy flake.

The woods are lovely, dark and deep,
But I have promises to keep,
And miles to go before I sleep,
And miles to go before I sleep.

I Sing the Pioneer: Daniel Boone

Arthur Guiterman

Daniel Boone at twenty-one
Came with his tomahawk, knife and gun
Home from the French and Indian War
To North Carolina and the Yadkin shore.
He married his maid with the golden band,
Built his house and cleared his land;
But the deep woods claimed their son again
And he turned his face from the homes of men.
Over the Blue Ridge, dark and lone,
The Mountains of Iron, the Hills of Stone,
Braving the Shawnee's jealous wrath,
He made his way on the Warrior's Path.
Alone he trod the shadowed trails;
But he was the lord of a thousand vales
As he roved Kentucky far and near,
Hunting the buffalo, elk and deer.
What joy to see, what joy to win
So fair a land for his kith and kin,
Of streams unstained and woods unhewn!
"Elbowroom!" laughed Daniel Boone.

On the wilderness road that his axman made
The settlers flocked to the first stockade;
The deerskin shirts and the coonskin caps
Filed through the glens and the mountain gaps;
And hearts were high in the fateful spring
When the land said "Nay" to the stubborn king.
While the men of the East of farm and town
Strove with the troops of the British Crown,
Daniel Boone from a surge of hate
Guarded a nation's westward gate.
Down on the ford in a wave of flame
The Shawnee horde and the Mingo came
And the stout logs shook in a storm of lead;
But Boone stood firm and the savage fled.
Peace! And the settlers flocked anew,
And the farmlands spread, the town lands grew;
But Daniel Boone was ill at ease
When he saw the smoke in his forest trees.
"There'll be no game in the country soon.
Elbowroom!" cried Daniel Boone.

I Sing the Pioneer: Daniel Boone
(Continued)

Straight as a pine at sixty-five
Time enough for a man to thrive -
He launched his bateau on Ohio's breast
And his heart was glad as he oared it west;
There were kindly folks and his own true blood
Where great Missouri rolls his flood;
New woods, new streams and room to spare,
And Daniel found comfort there.
Yet far he ranged toward the sunset still,
Where Kansas runs and the Smoky Hill,
And the prairies toss, by the south wind blown;
And he killed his bear on the Yellowstone.
But ever he dreamed of new domains
With vaster woods and wider plains;
Ever he dreamed of a world-to-be
Where there are no bounds and the soul is free.
At four-score-five, still stout and hale,
He heard a call to a father trail;
So he turned his face where the stars are strewn;
"Elbowroom!" sighed Daniel Boone.

Down the Milky Way in its banks of blue
Far he has paddled his white canoe
To the splendid quest of the tameless soul
He has reached the goal where there is no goal.
Now he rides and rides on endless trail
On the Hippogriff of the flaming tail
Or the Horse of the Stars with the golden mane
As he rode the first of the blue-grass strain.
The joy that lies in the Search he seeks
On breathless hills with crystal peaks;
He makes his camp on heights untrod
The steps of the Shrine, alone with God.
Through the woods of the vast, on the plains of Space
He hunts the pride of the Mammoth race
And the Dinosaur of the triple horn,
And Manticore and the Unicorn,
As once by the broad Missouri's flow
He followed the elk and the buffalo.
East of the Sun and west of the Moon,
"Elbowroom!" laughs Daniel Boone.

The Frog

Hilaire Belloc

Be kind and tender to the Frog,
And do not call him names,
As "Slimy-skin", or "Pollywog",
Or likewise "Uncle James",
Or "Gape-a-grin", or "Toad-gone-wrong",
Or "Billy Bandy-knees";
The frog is justly sensitive
To Epithets like these.

No animal will more repay
A treatment kind and fair,
At least so lonely people say
Who keep a frog (and, by the way,
They are extremely rare).

Ducks

F. W. Harvey

I

From troubles of the world
I turn to ducks,
Beautiful comical things
Sleeping or curled,
Their heads beneath white wings
By water cool,
Or finding curious things
To eat in various mucks
Beneath the pool,
Tails uppermost, or waddling
Sailor-like on the shores
Of ponds, or paddling
-left! right! - with fan-like feet
Which are for steady oars
When they (white galleys) float
Each bird a boat
Rippling at will the sweet
Wide waterway...
When night is fallen you creep
Upstairs; but drakes and dillies
Nest with pale water-stars.

Moonbeams and shadow bars,
And water-lilies:
Fearful too much to sleep
Since they've no locks
To click against the teeth
Of weasel and fox.
And warm beneath
Are eggs of cloudy green
Whence hungry rats and lean
Would stealthily suck
New life, but for the mien,
The bold ferocious mien,
Of the mother-duck.

Ducks
(Continued)

II

Yes, ducks are valiant things
On nests of twigs and straw,
And ducks are soothy things
And lovely on the lake
When the sunlight draws
Thereon their pictures dim
In colors cool.
And when beneath the pool
They dabble, and when they swim
And make their rippling rings,
O! Ducks are beautiful things!
But ducks are comical things:
As comical as you.
Quack!
They waddle round, they do.
They eat all sorts of things,
And then they quack.
By barn and stable stack
They wander at their will,
But if you go too near
They look at you through black
Small topaz-tinted eyes
And wish you ill.
Triangular and clear
They leave their curious track
In mud at the water's edge,
And there amid the sedge
And slime they gobble and peer
Saying "Quack! Quack!"

III

When God had finished the stars and whirl of colored suns
He turned his mind from big things to fashion little ones,
Beautiful tiny things (like daisies) He made, and then
He made the comical ones in case the minds of men
  Should stiffen and become
  Dull, humorless and glum:
And so forgetful of their Maker be
As to take even themselves - quite seriously.
Caterpillars and cats are lively and excellent puns:
All God's jokes are good - even the practical ones!
And as for the duck, I think God must have smiled a bit
Seeing those bright eyes blink on the day He fashioned it.
And He's probably laughing still at the sound that came
  out of its bill!

BLOOMING TIMES OF COMMON WILDFLOWERS OF THE GEORGIA PIEDMONT[1]

The following are normal blooming times in the DeKalb County area--exact times in your area might be 7 to 10 days earlier or later.

January	Hepatica
February	
Second Week	Red Maple
Third Week	Ground Ivy
March	
First Week	Periwinkle
Second Week	Oconee Bells
Third Week	Spring Beauty, Peach, Bloodroot, Confederate Violet, Spicebush
Fourth Week	Wild Columbine, Redbud, Toad Trillium, Bishop's Cap
April	
First Week	Wild Ginger, Wisteria, Bellwort, Yellow Trillium, Large-Flowered Trillium, Bleeding Heart, Sweet Shrub, Sassafras, Pinxter-Flower
Second Week	Flowering Dogwood, Pinkshell Azalea, Foamflower, Nodding Trillium, Wake Robin, Wild Geranium
Third Week	Jack-in-the-Pulpit, Pink Lady Slipper, Yellow Lady Slipper, Vernal Iris, Umbrella Magnolia, Princess Tree
Fourth Week	Blue-Eyed Grass, Lyre-Leaf Sage, Flame Azalea, Tulip Tree
May	
Third Week	Day Lily, Partridge Berry, Indian Pink
Fourth Week	White Swamp Azalea, Mountain Laurel, Indian Physic

[1]Based on data collected over a 6 year span by David Funderburk of Fernbank Science Center, DeKalb County School System, DeKalb County, Georgia.

INSTRUCTIONS FOR COLLECTING, PRESSING, DRYING, AND MOUNTING PLANTS

The establishment of a personal herbarium or even a simple plant collection may seem quite complicated when viewed from a distance; however, by following a few simple rules it can easily be done. Although many mistakes usually are made, a person can soon master the techniques needed to preserve most plant specimens. Much personal satisfaction can be derived from a collection that is done well. Individual specimens can be used for classroom study, bulletin boards, or room decorations.

COLLECTING

The tools needed for collecting plants are simple, inexpensive, and easy to procure. A plastic laundry bag (preferably one with a draw string) and a knife or pair of clippers are the two most important tools needed. Most plants will remain fresh for as long as 24 hours in the plastic bag if a little water is placed in it, although plants such as ferns, honey locust, black locust and mimosa need to be placed in a press immediately. Those specimens that curl quickly can be placed in a large magazine that can be carried in the field.

Pick a specimen that shows as many of the characteristics of the plant as possible. Include flowers, fruit, seeds, seed pods, etc., as well as a number of leaves. If the plant has compound leaves, be sure that you collect the whole leaf and not just a leaflet. If possible collect from a mature plant. The leaves of some young plants, especially some of the oaks, are different in size and shape than those on a mature tree.

It is advisable to write down the geographical location, habitat, date, and name of the specimen at once. Many beautiful specimens are taken home and have to be thrown away because the collector cannot remember what it is or where he got it.

PRESSING

Ideally, within a few minutes after a plant has been collected it should be put into a press. The top and bottom frames of a press are composed of thin, strong pieces of wood laid together at right angles so as to make a lattice. It normally measures 12 x 18 inches. Between the frames are driers or sheets of moisture-absorbing material which may be blotters or felt papers or even newspaper. The specimen is placed between one thickness of once-folded newspaper which is, in turn, placed between the felt papers. Corrugated cardboard covers the specimen and the felt papers. After a stack of these sets are arranged and the frames are placed on the top and bottom, pressure should be applied by securely tying clothes line or window sashcord around the press. A weight of one hundred pounds is not excessive.

HINTS ON PRESSING

Arrange the plant as you would like to have it appear in the dried condition. Turn some of the leaves so that the bottom shows. Clean underground parts of all dirt. Add extra flowers, fruits, etc., if they are available. After the specimens have dried for a few hours the press may be opened and leaves that have been wrinkled or partially turned may be straightened. If the plants are fleshy, the absorbent papers may have to be changed every day or two.

A thin press can be taken into the field and absorbent papers and corrugated cardboard can be added later. A piece of cardboard should separate every five or ten specimens.

DRYING

After plants are put into a press they will usually dry in two or three days depending on the weather and humidity. An attic is a good place to keep it during warm weather. To speed up the drying process the press can be placed close to a heater of some type. Botanists have special racks on which to place drying specimens which consists of boxes which have inside them either heating coils or perhaps a few light bulbs. Specimens usually dry in 12 to 16 hours.

Two common mistakes plague the beginning botanists. If specimens are wrinkled when they are removed from the press, not enough pressure was exerted on them. If they are blackish or moldy, drying occurred too slowly.

MOUNTING

After a specimen is completely dried it should be mounted on a good grade of stiff white paper. Herbarium paper (sold by biological supply houses) is 11-1/2 x 16-1/2 inches. A quick-drying clear-drying glue (such as Elmer's or Dupont's "Duco") should be used to attach the specimen to the herbarium paper. Narrow strips of white linen book binding tape helps to hold the specimen in place. Scotch tape, draftmens tape, or gummed paper should be avoided because they lose their adhesive qualities after a time. The herbarium sheet should be pressed down gently while the glue is drying to prevent the paper from curling.

The label is usually glued at the lower right hand corner of the sheet. It is usually about 3 x 5 inches in size and should include the following information: (1) a heading that indicates the state or country of the collection, and usually the name of the person or institution with which the specimen originated; (2) the genus and species, with authority; (3) the locality of collection; (4) the habitat; (5) the collection date; (6) the name of the collector; and (7) other information about flowers or flower parts not readily seen in the pressed specimen. In some cases it may be better to record facts such as height of the plant, abundance of the plant in the area, the altitude of the locality, and if the plant is a large shrub or a tree and the nature of the bark.

If the specimen is too large to fit on the herbarium sheet, it may be bent or folded into a "V" or "W".

When specimens are stored they should be covered to protect them from dust and insects. Place insect repellent such as moth balls or para-di- chloro-benzene crystals in the container with them.

Cuthbert, Mabel Jaques. How to Know the Spring Flowers. Wm. C. Brown Company, Dubuque, Iowa, 1949.

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Westfall, Jonathan J. and Wilbur H. Duncan. "Directions for Pressing, Drying and Mounting Plants." University of Georgia.

NON-FLOWERING PLANTS

REFERENCES

REFERENCE:

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INTRODUCTION TO FERNS AND OTHER SEEDLESS VASCULAR PLANTS

Because of their unusual, beautiful, feathery form few groups of plants have elicited more interest and admiration than ferns. Professional botanists as well as casual observers have long been interested in ferns because of the beauty of their foliage, their usual association with deeply shaded woodlands, their lack of flowers and seeds, and their possible relationship to plants of ancient geologic eras when coal was being formed.

Living ferns comprise a group of approximately 200 genera and 8,000 species. Approximately 60 species have been found in Georgia in addition to 21 species of horsetails, clubmosses, spikemosses, quillworts, and Psilotum.

Ferns and their relatives are found almost everywhere plants grow except in the sea. Although they are most abundant in moist, shaded habitats, especially in the tropics, they are also found in shallow soil on dry rocks, in open field, floating or growing in water, in deserts, in the Arctic and in tropical jungles. There are epiphytic ferns, tree ferns, and even vining ferns. They have true leaves, stems, and roots. Most of those found in Georgia have underground rhizomes. Ferns vary in size from 60-ft. tropical tree ferns to the minute mosquito fern which may be only a fraction of an inch long.

Vegetative Characters of the Sporophyte

Ferns found in Georgia and other temperate regions are typically perennial, producing one or more leaves each year at the growing end of the rhizome. The rhizome (underground stem) usually lies horizontally just below the surface of the soil or in the leaf mold at its surface.

It is difficult to estimate the life span of a fern, for each year the forward portion (the apex of the stem) grows in length and produces one or more leaves while the older portion in the rear decomposes. By repeated branching and continued growth it is possible that a single fern plant might, after a few centuries, occupy several acres and appear as hundreds of separate plants.

Fern leaves range in size from only a centimeter or less to giant leaves several feet in length. Although a few ferns, such as the walking fern, have undivided or entire leaf blades, the majority have compound or highly lobed leaves (pinnatifid). A compound leaf may be once-compound (pinnate) with a central rachis or midrib and a row of leaflets or pinnae on each side. Leaves of some species are twice-compound (twice-pinnate or bipinnate) with leaflets further divided into smaller leaflets called pinnules. A few species are tripinnate, or even further divided.

The veins in the leaves of many fern species are double-forked repeatedly or dichotomously branched. Most young fern leaves unfold gradually outward from an internal coil or spiral. The coiled young leaves are called "crosiers" or "fiddleheads" because of the typical form this circinate vernation or unrolling gives them.

Life History of Ferns

During the summer, late spring, or early fall most ferns produce their spores. Clusters of sporangia (spore cases) develop on the lower (abaxial) surface of some of the leaves. Leaves that produce sporangia are called fertile fronds in contrast to the strictly vegetative and photosynthetic sterile fronds. Sterile and fertile fronds may be very similar in appearance or they may contrast sharply in appearance. Clusters of sporangia are called sori (singular, sorus). In some species the sori are covered by shield-like layers of sterile tissue called indusia.

The size, shape, and arrangement of sori differ greatly from species to species and are extremely useful in identification. In the Lady Fern, for example, the sori are crescent-shaped; in the Rockcap Fern they are circular and without indusia; in the Marginal Shield Fern they are kidney shaped with a peltate indusium, while in the Maidenhair Fern the sori are marginal and the indusium that covers them appears to be the rolled-under edge of the leaf.

Each mature sporangium has a distinct stalk and an expanded capsule or spore case filled with haploid spores which are produced by meiosis in which the chromosome number is reduced from the 2n or diploid number to the n or haploid number. Most fern sporangia have a special row of cells which are thickened on their inner and lateral walls and which extend approximately three-fourths of the circumference of the capsule. This row of cells, the annulus, is very sensitive to changes in moisture, straightening out or recoiling with changes in humidity. When the annulus first straightens out, it tears open the relatively weak walls of the spore case opposite the annulus, liberating part of the spores. The back of the capsule then bends slowly backward as drying out proceeds, building up tension in the annulus cells. These suddenly break or release their tension with a violent snap forward, throwing the remaining spores into the air.

In most ferns the thousands of spores produced on a single frond are all approximately the same size, i.e., they are homosporous. However, the water ferns, such as Salvinia, Azolla, and Marsilea, produce both large spores (megaspores) and small spores (microspores) which germinate to grow into female and male gametophytes respectively. Plants producing spores of different size in this manner are said to heterosporous. Sooner or later most spores are shed and fall to the ground, often after having been blown considerable distances by the wind.

Spores that fall by chance in moist shaded areas on proper soil soon germinate and form a rhizoid-bearing filament that grows into tiny, thin, flat, heart-shaped gametophyte or prothallus about the size of a punched hole in a piece of notebook paper. On the prothallus are produced the sex organs (antheridia and archegonia) of the fern. The gametophyte is therefore regarded as the sexual phase of the life cycle. The female cells (eggs) are produced in the archegonia located on the lower surface of the prothallus, usually near the distal notch. The male sex organs (antheridia) appear as small protruding structures also on the lower surface but near the pointed end of the prothallus. Usually 32 multiciliate sperm form in each antheridium and are ejected forcibly into the surrounding rain or dew when the cap cell of the antheridium breaks off at maturity. The venter or basal portion of the flask-shaped archegonium is buried in the prothallus and a short neck is extruded. Two cells within the neck disintegrate and the sperm swims down the canal thus formed to unite with the egg in the act of fertilization. Antheridia and archegonia of one prothallus mature at different times so that self-fertilization is prevented. The embryo sporophyte develops at the base of the archegonium from the fertilized egg (zygote) by repeated cell divisions. The developing embryo quickly produces a primary root, a primary stem, and a first leaf. The new sporophyte matures in about three years and begins to produce spores, thus completing the life cycle.

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KEY TO THE ABBREVIATIONS

o----order
f----family
sf---subfamily
pr---permanent resident
sr---summer resident
wr---winter resident
m----migratory
numbers (ex.: 3)----------months of the year (ex.: March)
small letters (ex.: c)----week of the month (ex.: 3rd week)

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o. Graviiformes
f. Gaviidae (loons)

NONE

o. Colymbiformes
f. Colymbidae (grebes)

PIED-BILLED GREBE Podilymbus podiceps podiceps (w:7d-5c)

o. Procellariiformes
f. Procellariidae (shearwaters and fulmars)
f. Hydrobatidae (storm petrels)

NONE

o. Pelecaniformes
f. Phaethontidae (tropic birds)
f. Pelecanidae (pelicans)
f. Sulidae (gannets and boobies)
f. Phalacrocoracidae (cormorants)
f. Anhingidae (darters)
f. Fregatidae (man-o'-war-birds)

NONE

o. Ciconiiformes
f. Ardeidae (herons and bitterns)

GREAT BLUE HERON Ardea herodias (p)

AMERICAN EGRET Casmerodius albus egretta (m: 7b-9d)

LITTLE BLUE HERON Florida coerulea coerulea (m: 3d-10a)

EASTERN GREEN HERON Butorides virescens virescens (s: 3c-10d)

f. Ciconiidae (storks and wood ibises)

f. Procellariidae (shearwaters and fulmars)
f. Hydrobatidae (storm petrels)

NONE

o. Pelecaniformes
f. Phaethontidae (tropic birds)
f. Pelecanidae (pelicans)
f. Sulidae (gannets and boobies)
f. Phalacrocoracidae (cormorants)
f. Anhingidae (darters)
f. Fregatidae (man-o'-war-birds)

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o. Ciconiiformes
f. Ardeidae (herons and bitterns)

GREAT BLUE HERON — Ardea herodias (p)

AMERICAN EGRET — Casmerodius albus egretta (m: 7b-9d)

LITTLE BLUE HERON — Florida coerulea coerulea (m: 3d-10a)

EASTERN GREEN HERON — Butorides virescens virescens (s: 3c-10d)

f. Ciconiidae (storks and wood ibises)
f. Threskiornithidae (ibises and spoonbills)
f. Phoenicopteridae (flamingos)

NONE

o. Anseriformes
f. Anatidae
sf. Cyginiae (swans)
sf. Anserinae (geese)
sf. Dendrocygninae (tree-ducks)

NONE

sf. Anatinae (surface-feeding ducks)

MALLARD — Anas platyrhynchos platyrhynchos (w: 11b-5b)

BLUE-WINGED TEAL — Anas discors (m: 3c-5c/8d-10c)

BALDPATE — Mareca americana (m: 2d-4b/10b-11a)

SHOVELLER — Spatula clypeata (m: 3a-4d/10d-11b)

WOOD DUCK — Aix sponsa (p)

sf. Aythyinae (diving ducks)

RING-NECKED DUCK — Aythya collaris (w: 10c-5c)

sf. Erismaturinae (ruddy and masked ducks)

sf. Merginae (mergansers)

NONE

o. Falconiformes

f. Catharitidae (vultures)

TURKEY VULTURE — Cathartes aura (p)

BLACK VULTURE — Coragyps atratus (p)

f. Elaninae (kites)

NONE

f. Accipitrinae (short-winged hawks)

SHARP-SHINNED HAWK — Accipiter striatus velox (p)

COOPER'S HAWK — Accipiter cooperii (p)

f. Buteoninae (buzzard hawks and eagles)

RED-TAILED HAWK — Buteo jamaicensis (p)

RED-SHOULDERED HAWK — Buteo lineatus (p)

BROAD-WINGED HAWK — Buteo platypterus platypterus (s:3c-10a)

f. Circinae (harriers)

MARSH HAWK — Circus cyaneus hudsonius (w:7d-5c)

f. Pandionidae (ospreys)

f. Polyborinae (caracaras)

NONE

f. Falconinae (falcons)

SPARROW HAWK (KESTREL) — Falco sparverius (p)

o. Galliformes

f. Tetraonidae (grouse)

NONE

f. Phasianidae (quails, partridges and pheasants)

BOB-WHITE — Colinus virginianus (p)

f. Meleagrididae (turkeys)

NONE

BROAD-WINGED HAWK Buteo platypterus platypterus (s:3c-10a)

f. Circinae (harriers)

MARSH HAWK Circus cyaneus hudsonius (w:7d-5c)

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f. Phasianidae (quails, partridges and pheasants)

BOB-WHITE Colinus virginianus (p)

f. Meleagrididae (turkeys)

NONE

o. Gruiformes

f. Gruidae (cranes)

f. Aramidae (limpkins)

NONE

f. Rallidae (rails, gallinules and coots)

AMERICAN COOT Fulica americana (w:9c-6a)

o. Charadriiformes

f. Haematopodidae (oyster-catchers)

NONE

f. Charadriidae (plovers and turnstones)

SEMIPALMATED PLOVER — Charadrius hiaticula semipalmatus (m: 4a-5d/7d-9a)

KILLDEER — Charadrius vociferus vociferus (p)

f. Scolopacidae (woodcock, snipe, sandpipers)

AMERICAN WOODCOCK — Philohela minor (p)

WILSON'S SNIPE — Capella gallinago delicata (w: 8b-5b)

SPOTTED SANDPIPER — Actitus macularia (s: 4a-10d)

(EASTERN) SOLITARY SANDPIPER — Tringa solitaria solitaria (m: 3c-5d/7b-10d)

GREATER YELLOW-LEGS — Totanus melanoleucus (m: 3c-5d/8c-11a)

LESSER YELLOW-LEGS — Totanus flavipes (m: 3a-5c/7d-10c)

PECTORAL SANDPIPER — Erolia melanotos (m: 3c-5a/7d-10c)

LEAST SANDPIPER — Erolia minutilla (m: 4a-5d/7c-9c)

f. Recurvirostridae (avocets and stilts)
f. Phalaropodidae (phalaropes)
f. Stercorariidae (jaegers)
f. Laridae (gulls and terns)
sf. Larinae (gulls)

NONE

sf. Sterninae (terns)

BLACK TERN — Chlidonias nigra surinamensis (m: 8a-9c)

f. Rynchopidae (skimmers)
f. Alcidae (anks, murres, and puffins)

NONE

o. Columbiformes
f. Columbidae (pigeons and doves)

ROCK DOVE (DOMESTIC PIGEON) — Columba livia (p)

MOURNING DOVE — Zenaidura macroura (p)

o. Psittaciformes
f. Psittacidae (parrots)

NONE

o. Cuculiformes
f. Cuculidae (cuckoos, anis, etc.)

YELLOW-BILLED CUCKOO — Coccyzus americanus americanus (s: 4b-10d)

BLACK-BILLED CUCKOO — Coccyzus erythrophthalmus (s: 4c-10b)

NONE

o. Columbiformes
f. Columbidae (pigeons and doves)

ROCK DOVE (DOMESTIC PIGEON) — Columba livia (p)

MOURNING DOVE — Zenaidura macroura (p)

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f. Psittacidae (parrots)

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f. Cuculidae (cuckoos, anis, etc.)

YELLOW-BILLED CUCKOO — Coccyzus americanus americanus (s: 4b-10d)

BLACK-BILLED CUCKOO — Coccyzus erythrophthalmus (s: 4c-10b)

o. Strigiformes
f. Tytonidae (owls)

NONE

f. Strigidae (owls)

SCREECH OWL — Otus asio (p)

BARRED OWL — Strix varia (p)

o. Caprimulgiformes
f. Caprimulgidae (goatsuckers)

CHUCK-WILL'S WIDOW	Caprimulgus carolinensis (s: 4b-8b)
NIGHT HAWK	Chordeiles minor (s: 4c-10d)
o. Apodiformes	
f. Apodidae (swifts)	
CHIMNEY SWIFT	Choetura pelagica (s: 3d-10d)
f. Trochilidae (hummingbirds)	
RUBY-THROATED HUMMINGBIRD	Archilochus colubris (s: 4a-10c)
o. Coraciiformes	
f. Alcedinidae (Kingfishers)	
(EASTERN) BELTED KINGFISHER	Megaceryle alcyon alcyon (p)
o. Piciformes	
f. Picidae (woodpeckers)	
FLICKER	Colaptes auratus (p)
PILEATED WOODPECKER	Hylatomus pileatus (p)
RED-BELLIED WOODPECKER	Centurus carolinus (p)
RED-HEADED WOODPECKER	Melanerpes erythrocephalus erythrocephalus (p)
YELLOW-BELLIED SAPSUCKER	Sphyrapicus varius varius (w: 9a-5a)
HAIRY WOODPECKER	Dendrocopus villosus (p)
DOWNY WOODPECKER	Dendrocopus pubescens (p)
o. Passeriformes	
f. Tyrannidae (flycatchers)	
EASTERN KINGBIRD	Tyrannus tyrannus (s: 4a-10b)
CRESTED FLYCATCHER	Myiarchus crinitus (s: 3c-9d)
EASTERN PHOEBE	Sayornis phoebe (p)
ACADIAN FLYCATCHER	Empidonax virescens (s: 4c-10b)
WOOD PEWEE	Contopus virens (s: 3c-10d)
f. Alaudidae (larks)	
HORNED LARK	Eremophila alpestris (p)
f. Hirundinidae (swallows)	
TREE SWALLOW	Iridoprocne bicolor (m: 3c-5d/7b-9b)
BANK SWALLOW	Riparia riparia riparia (m: 4d-5c/7b-9c)

EASTERN KINGBIRD	Tyrannus tyrannus (s: 4a-10b)
CRESTED FLYCATCHER	Myiarchus crinitus (s: 3c-9d)
EASTERN PHOEBE	Sayornis phoebe (p)
ACADIAN FLYCATCHER	Empidonax virescens (s: 4c-10b)
WOOD PEWEE	Contopus virens (s: 3c-10d)
f. Alaudidae (larks)	
HORNED LARK	Eremophila alpestris (p)
f. Hirundinidae (swallows)	
TREE SWALLOW	Iridoprocne bicolor (m: 3c-5d/7b-9b)
BANK SWALLOW	Riparia riparia riparia (m: 4d-5c/7b-9c)
ROUGH-WINGED SWALLOW	Stelgidopteryx ruficollis serripennis (s: 3c-8d)
BARN SWALLOW	Hirundo rustica erythrogaster (m: 4d-5d/7d-10d)
PURPLE MARTIN	Progne subis subis (s: 3a-9d)
f. Corvidae (crows and jays)	
BLUE JAY	Cyanocitta cristata (p)
CROW	Corvus brachyrhynchos (p)
f. Paridae (titmice)	

CAROLINA CHICKADEE	Parus carolinensis (p)
TUFTED TITMOUSE	Parus bicolor (p)
f. Sittidae (nuthatches)	
WHITE-BREASTED NUTHATCH	Sitta carolinensis (p)
RED-BREASTED NUTHATCH	Sitta canadensis (w: 9d-4a)
BROWN-HEADED NUTHATCH	Sitta pusilla (p)
f. Certhiidae (creepers)	
BROWN CREEPER	Certhia familiaris (w: 10d-4c)
f. Troglodytidae (wrens)	
HOUSE WREN	Troglodytes aëdon (p)
WINTER WREN	Troglodytes troglodytes (w: 10b-4d)
CAROLINA WREN	Thryothorus ludovicianus (p)
f. Mimidae (mocking birds and thrashers)	
(EASTERN) MOCKINGBIRD	Mimus polyglottos polyglottos (p)
CATBIRD	Dumetella carolinensis (s: 4a-10d)
(EASTERN) BROWN THRASHER	Toxostoma rufum rufum (p)
f. Turdidae (thrushes, robins, bluebirds, etc.)	
ROBIN	Turdus migratorius (p)
WOOD THRUSH	Hylocichla mustelina (s: 4a-10d)
(EASTERN) HERMIT THRUSH	Hylochichla guttata faxon (w: 10b-4d)
OLIVE-BACKED THRUSH	Hylocichla ustulata (m: 4c-5d/ 8d-11b)
GRAY-CHEEKED THRUSH	Hylocichla minima (m: 4b-5b/ 9a-11a)
VEERY	Hylocichla fuscescens (m: 4d-5c/ 8d-10a)
EASTERN BLUEBIRD	Sialia sialis (p)
f. Sylviidae (gnatcatchers and kinglets)	
BLUE-GRAY GNATCATCHER	Polioptila coerulea coerulea (s: 3b-10b)
(EASTERN) GOLDEN-CROWNED KINGLET	Regulus satrapa satrapa (w: 10b-4b)
(EASTERN) RUBY-CROWNED KINGLET	Regulus calendula calendula (w: 9d-5c)
f. Motacillidae (pipits)	
AMERICAN PIPIT	Anthus spinoletta rubescens (w: 10d-4c)

VEERY	Hylocichla fuscescens (m: 4d-5c/ 8d-10a)
EASTERN BLUEBIRD	Sialia sialis (p)
f. Sylviidae (gnatcatchers and kinglets)	
BLUE-GRAY GNATCATCHER	Polioptila coerulea coerulea (s: 3b-10b)
(EASTERN) GOLDEN-CROWNED KINGLET	Regulus satrapa satrapa (w: 10b-4b)
(EASTERN) RUBY-CROWNED KINGLET	Regulus calendula calendula (w: 9d-5c)
f. Motacillidae (pipits)	
AMERICAN PIPIT	Anthus spinoletta rubescens (w: 10d-4c)
f. Bombycillidae (waxwings)	
CEDAR WAXWING	Bombycilla cedrorum (w: 10b-5d)
f. Laniidae (shrikes)	
LOGGER HEAD SHRIKE	Lanius ludovicianus (p)
f. Sturnidae (starlings)	
STARLING	Sturnus vulgaris vulgaris (p)
f. Vireonidae (vireos)	
WHITE-EYED VIREO	Vireo griseus (s: 3d-10c)

YELLOW-THROATED VIREO	Vireo flavifrons (s: 3d-10d)
(SOLITARY) BLUE-HEADED VIREO	Vireo solitarius (p)
RED-EYED VIREO	Vireo olivaceus (s: 4a-10d)

f. Parulidae (wood warblers)

BLACK AND WHITE WARBLER	Mniotilta varia (s: 3c-10d)
PROTHONOTARY WARBLER	Protonotaria citrea (s: 4c-10a)
WORM-EATING WARBLER	Helmitheros vermirorus (s: 4b-10b)
GOLDEN-WINGED WARBLER	Vermivora chrysoptera (m: 4b-5b/8a-10b)
BLUE-WINGED WARBLER	Vermivora pinus (s: 3d-9d)
TENNESSEE WARBLER	Vermivora peregrina (m: 4d-5c/9a-11a)
ORANGE-CROWNED WARBLER	Vermivora celata celata (w: 10d-5a)
PARULA WARBLER	Parula americana (s: 4a-10c)
YELLOW WARBLER	Dendroica petechia (s: 4b-10a)
MAGNOLIA WARBLER	Dendroica magnolia (m: 4c-5d/8d-11a)
CAPE MAY WARBLER	Dendroica tigrina (m: 4b-5b/10a-11b)
BLACK-THROATED BLUE WARBLER	Dendroica coerulescens (m: 4b-5b/9a-10d)
MYRTLE WARBLER	Dendroica coronata coronata (w: 9d-5c)
BLACK-THROATED GREEN WARBLER	Dendroica virens (m: 3d-5b/9a-10d)
CERULEAN WARBLER	Dendroica cerulea (m: 4c-5c/7d-9b)
BLACKBURNIAN WARBLER	Dendroica fusca (m: 4a-5d/8b-10d)
YELLOW-THROATED WARBLER	Dendroica dominica (s: 3b-10a)
CHESTNUT-SIDED WARBLER	Dendroica pensylvanica (m: 4c-5d/8b-10d)
BAY-BREASTED WARBLER	Dendroica castanea (m: 4d-5d/8d-11a)
BLACK-POLL WARBLER	Dendroica striata (m: 4b-5d)
PINE WARBLER	Dendroica pinus (p)
PRAIRE WARBLER	Dendroica discolor (s: 3d-10d)
PALM WARBLER	Dendroica palmarum (w: 9b-5b)
OVEN-BIRD	Seiurus aurocapillus (s: 4a-10c)

BLACKBURNIAN WARBLER	Dendroica fusca (m: 4a-5d/8b-10d)
YELLOW-THROATED WARBLER	Dendroica dominica (s: 3b-10a)
CHESTNUT-SIDED WARBLER	Dendroica pensylvanica (m: 4c-5d/8b-10d)
BAY-BREASTED WARBLER	Dendroica castanea (m: 4d-5d/8d-11a)
BLACK-POLL WARBLER	Dendroica striata (m: 4b-5d)
PINE WARBLER	Dendroica pinus (p)
PRAIRE WARBLER	Dendroica discolor (s: 3d-10d)
PALM WARBLER	Dendroica palmarum (w: 9b-5b)
OVEN-BIRD	Seiurus aurocapillus (s: 4a-10c)
NORTHERN WATER-THRUSH	Seiurus noveboracensis (m: 4c-5d/8c-10c)
LOUISIANA WATER-THRUSH	Seiurus motacilla (s: 3a-10a)
KENTUCKY WARBLER	Oporornis formosus (s: 4a-10a)
YELLOW-THROAT	Geothlypis trichas (p)
YELLOW-BREASTED CHAT	Icteria virens virens (s: 4c-9d)

HOODED WARBLER	Wilsonia citrina (s: 3c-10d)
CANADA WARBLER	Wilsonia canadensis (m: 4d-5d/ 8a-10a)
AMERICAN RED START	Setophaga ruticilla (s: 4a-10d)
f. Ploceidae (weaver finches)	
HOUSE (ENGLISH) SPARROW	Passer domesticus domesticus (p)
f. Icteridae (meadowlarks, blackbirds and orioles)	
BOBOLINK	Dolichonyx oryzivorus (m: 4d-5d/8d-10c)
MEADOWLARK	Sturnella magna (p)
RED-WING	Agelaius phoeniceus (p)
ORCHARD ORIOLE	Icterus spurius (s: 4b-8b)
BALTIMORE ORIOLE	Icterus galbula (p)
RUSTY BLACKBIRD	Euphagus carolinus (w: 9c-4d)
PURPLE GRACKLE	Quiscalus quiscula (p)
(EASTERN) COWBIRD	Molothrus ater ater (p)
f. Thraupidae (tanagers)	
SCARLET TANAGER	Piranga olivacea (m: 4a-6a/9a-10d)
SUMMER TANAGER	Piranga rubra rubra (s: 4b-10d)
f. Fringillidae (grosbeaks, finches, sparrows, and buntings)	
CARDINAL	Richmondena cardinalis (p)
ROSE-BREASTED GROSBEAK	Pheucticus ludovicianus (m: 4b-5c/9c-10d)
(EASTERN) BLUE GROSBEAK	Guiraca coerulea coerulea (s: 4c-10a)
INDIGO BUNTING	Passerina cyanea (s: 4a-10d)
(EASTERN) PURPLE FINCH	Carpodacus purpureus purpureus (w: 10d-4d)
PINE SISKIN	Spinus pinus pinus (w: 11a-5b)
COMMON (EASTERN) GOLDFINCH	Spinus tristis tistis (p)
TOWHEE	Pipilo erythrophthalmus (p)

f. Fringillidae (grosbeaks, finches, sparrows, and buntings)

CARDINAL	*Richmondena cardinalis* (p)
ROSE-BREASTED GROSBEAK	*Pheucticus ludovicianus* (m: 4b-5c/9c-10d)
(EASTERN) BLUE GROSBEAK	*Guiraca coerulea coerulea* (s: 4c-10a)
INDIGO BUNTING	*Passerina cyanea* (s: 4a-10d)
(EASTERN) PURPLE FINCH	*Carpodacus purpureus purpureus* (w: 10d-4d)
PINE SISKIN	*Spinus pinus pinus* (w: 11a-5b)
COMMON (EASTERN) GOLDFINCH	*Spinus tristis tistis* (p)
TOWHEE	*Pipilo erythrophthalmus* (p)

SAVANNAH SPARROW	Passerculus sandwichensis (w: 10a-5c)
GRASSHOPPER SPARROW	Ammodranus savannarum (p)
(EASTERN) VESPER SPARROW	Pooecetes gramineus gramineus (w: 10c-5a)
(BACHMAN'S) PINE WOODS SPARROW	Aimophila oestivalis (p)
SLATE-COLORED JUNCO	Junco hyemalis (w: 10c-4d)
(EASTERN) CHIPPING SPARROW	Spizella passerina passerina (p)
(EASTERN) FIELD SPARROW	Spizella pusilla pusilla (p)
WHITE-THROATED SPARROW	Zonotrichia albicollis (w: 10 -5c)
(EASTERN) FOX SPARROW	Passerella iliaca iliaca (w: 11b-4a)
SWAMP SPARROW	Melospiza georgiana (w: 10a-5b)
SONG SPARROW	Melospiza melodia (w: 10a-5b)

MAMMALS OF DEKALB COUNTY

SCIENTIFIC NAME	COMMON NAME	SLIDE	LENGTH	HABITAT
			ORDER MONETREMATA -- NONE	
			ORDER MARSUPIALIA	
Didelphis marsupialis	Opossum		Head & body--15-20" Tail--9-20"	woodlands along streams
			ORDER INSECTIVORA	
Sorex longirostris	Southeastern Shrew		Head & body--2-2½" Tail--1-1½"	open fields and wood lots moist areas preferred
Cryptotis parva	Least Shrew		Head & body--2 1/5-2½" Tail--½-3/4"	open grass-covered areas, scattered brush, marshes
Blarina brevicauda	Shorttail Shrew		Head & body--3-4" Tail--3/4-1 1/5"	forests, grasslands, marshes, brushy areas
Scalopus aquaticus	Eastern Mole		Head & body--4½-6½" Tail--1-1½"	moist sandy loam, leaves, lawns, gardens, fields, and meadows
			ORDER EDENTATA -- NONE	
			ORDER CHIROPTERA	
Myotis lucifugus	[redacted] Little Brown Myotis		73-85 mm.	caves, mine tunnels, hollow trees, buildings
Myotis keeni	Keen Myotis (?)		79-88 mm.	mine tunnels, caves, buildings, hollow trees, storm sewers, forested areas
Myotis sodalis	Indi[redacted] Myotis (?)		70-90 mm.	winter:caves, summer: buildings, hollow trees

3 COUNTY

	HABITAT	DIET
ETREMATA -- NONE		
SUPIALIA		
15-20"	woodlands along streams	omnivorous, mainly insects
ECTIVORA		
2-2½"	open fields and wood lots, moist areas preferred	insects, worms, small animals
2 1/5-	open grass-covered areas, scattered brush, marshes	insects, earthworms, cenipedes, snails, vegetable matter
3-4" /5"	forests, grasslands, marshes, brushy areas	insects, worms, snails, possibly young mice
4½-6½"	moist sandy loam, leaves, lawns, gardens, fields, and meadows	worms, insects, some vegetable matter
ENTATA -- NONE		
IROPTERA		
	caves, mine tunnels, hollow trees, buildings	insects
	mine tunnels, caves, buildings, hollow trees, storm sewers, forested areas	unknown
	winter:caves, summer: buildings, hollow trees	unknown

Lasionycteris noctivagans	Silver-Haired Bat		92-113 mm.
Pipistrellus subflavus	Eastern Pipistrel		71-83 mm.
Eptesicus fuscus	Big Brown Bat		99-122 mm.
Lasiurus borealis	Red Bat		88-107 mm.
Lasiurus seminolus	Seminole Bat Mahogany Bat		104-108 mm.
Lasiurus cinereus	Hoary Bat		approximately 140 mm.
Nycticeius humeralis	Evening Bat		79-92 mm.
Corynorhinus macrotis	Eastern Big-Eared Bat		90-96 mm.
Tadarida brasiliensis	Mexican Freetail Bat		91-96 mm.
			ORDER RO
Marmota monax	Woodchuck (?) Ground Hog Marmot		Head & body-- Tail--4-7"
Tamias striatus	Eastern Chipmunk		Head & body-- Tail--3-4"

	forested areas, buildings, usually not caves	unknown
	caves, mine tunnels, buildings, crevices in rocks, wooded areas; near water	flies, beetles, hymenopterans
	caves, tunnels, crevices, hollow trees, buildings, wooded areas	insects, chiefly beetles
	wooded areas, roosts in trees, occasionally caves	insects, especially moths and beetles
	wooded areas, trees for roosts	insects
	wooded areas (winter resident)	unknown
	buildings, hollow trees	unknown
	caves, mine tunnels, buildings	unknown
	caves and buildings for roosts	insects, especially winged ants, beetles, and moths
DENTIA		
16-20"	open woods, brushy and rocky ravines	tender plants
5-6"	deciduous forests, brushy areas	seeds, bulbs, fruits, nuts, small birds, insects, eggs, mice

Sciurus carolinensis	Eastern Gray Squirrel	Head & body--8 Tail--7 3/4-10
Sciurus niger	Eastern Fox Squirrel	Head & body--1 Tail--9-14"
Glancomys volans	Southern Flying Squirrel	Head & body--5 Tail--3½-4½"
Castor canadensis	Beaver	Head & body--2 Tail--9-10"
Reithrodontomys humulis	Eastern Harvest Mouse	Head & body--2 Tail--1 4/5-2½
Peromyscus polionotus	Oldfield Mouse Beach Mouse	Head & body--3 Tail--1 3/5- 2 3/5
Peromyscus leucopus	Whited-Footed Mouse Wood Mouse	Head & body--3 Tail--2 2/5-4"
Peromyscus nuttalli	Golden Mouse	Head & body--3 Tail--3-3 3/5"
Neotoma floridana	Eastern Woodrat (?)	Head & body--8 Tail--6-8"
Oryzomys palustris	Rice Rat	Head & body--4 Tail--4 1/3-7 5/8
Sigmodon hispidus	Hispid Cotton Rat	Head & body--5 Tail--3 1/5-6"

-10"	hardwood forests with nut trees, river bottoms	nuts, seeds, fungi, fruits, bark, roots, insects
0-15"	open hardwood woodlots with clearings interspersed	nuts, seeds, fungi, bird eggs, bark, leaves, berries, grasses, insects
½-5 2/3"	woodlots and forests of deciduous or mixed deciduous-coniferous forests	seeds, nuts, fruits, insects, small birds and eggs
5-30"	streams and lakes with trees on banks	bark and small twigs of sweetgum, pine, populars, maple, willow and alder
3/5-3"	old fields, marshes, wet meadows	small grasses, herb seeds green sprouts of plants
2/5-/4/5" 2/5"	herbaceous stage of old field succession in sandy old fields	seeds of grass and herbs, insects
3/5-4½"	wooded or brushy areas preferred, sometimes open areas	seeds, nuts, insects
2/5-4/5"	forests, edges of canebrakes, moist thickets, honeysuckle	fruits, seeds, and herbaceous materials
-9"	dense vegetation near lowlands, swamps	seeds, nuts, fruits, insects
3/4-1/5" 1/5"	marshy areas, grasses, sedges	green vegetation, seeds, insects, crabs
-8"	cut grasses, honeysuckle, blackberries, broomsedge	herbaceous plants, grass, broomsedge, insects

Microtus pennsylvanicus	Meadow Vole (?)		Head & body--3 Tail--1 2/5-2
Pitymys pinetorum	Pine Vole		Head & body--3 m 4 Tail--2/3-1"
Ondatra zibethica	Muskrat		Head & body--1 Tail--8-11"
Rattus norvegicus	Norway Rat Brown Rat House Rat Wharf Rat		Head & body-- Tail--5-8"
Mus musculus	House mouse		Head & body-- 3 Tail--2 4/5-3
Zapus hudsonius	Meadow Jumping Mouse		Head & body-- Tail--4-5 4/5
			ORDER
Sylvilagus floridanus	Eastern Cottontail		Head & body-- ~~XXXXX~~ Ear--2½-3"
Sylvilagus aquaticus	Swamp Rabbit Cane-Cutter		Head & body-- Ear--3½-4"
			ORDER C
			ORDER S

½-5" 3/5"	low moist areas or high grasslands with rank growth; near streams, lakes, occasionally in forests with little ground cover	grasses, sedges, seeds, grain, bark, some insects
4/5-1/5"	forest floor in deciduous forests	roots, bulbs, tubers, seeds
0-14"	marshes, edge on ponds, lakes, streams, cattails and rushes	aquatic vegetation, clams, frogs, fish
7-10"	farms, garbage dumps, houses, etc.	omnivorous, prefers grain
3 1/5-2/5" 4/5"	occasionally in fields, usually buildings	omnivorous
3 1/3"	various land habitats, prefers low meadows	seeds, insects, fruits
LAGOMORPHA		
14-17"	heavy brush, strips of forests with open areas nearby, edges of swamps, weed patches	green vegetation, bark and twigs
14-17"	swamps, marshes, wet bottomlands	aquatic and land herbaceous materials
ETACEA -- NONE		
IRENIA -- NONE		

Procyon lotor	Raccoon Coon Ringtail	Head & body- Tail--8-12"
Mustela frenata	Longtail Weasel	Head & body- Tail--3-6"
Mustela vison	Mink	Head & body- Tail--5-9"
Lutra canadensis	River Otter (?)	Head & body- Tail--12-17"
Spilogale putorius	Spotted Skunk Civit Hydrophobia Cat	Head & body- Tail--4½-9"
Mephitis mephitis	Striped Skunk	Head & body- Tail--7-10"
Canis latrans	Coyote (?) Brush Wolf	Head & body- Tail--11-16"
Vulpes fulva	Red Fox	Head & body- Tail--14-16"
Urocyon cinereoargenteus	Gray Fox	Head & body- Tail--11-16"

ER PROBOSCIDEA -- NONE

RDER CARNIVORA

-18-28"	along streams and lakes where there are wooded areas or rock cliffs nearby	omnivorous, such as grains, fruits, grass, frogs, bird eggs, crayfish
-8-10½"	all land habitats near water	small mammals & birds
-12-17"	along streams & lakes	small mammals, birds, eggs, frogs, crayfish, fish
-26-30"	along streams & lakes	fish, frogs, crayfish, and other aquatic invertebrates
-9-13½"	brushy or sparsely wooded areas, along streams, among boulders	mice, birds, eggs, insects, carrion, and some vegetable matter
-13-18"	mixed woods and brushlands	mice, eggs, insects, grubs, berries, carrion
-32-37"	open woodlands, brushy areas	any animal or vegetable, prefers small rodents and rabbits
-22-25"	mixture of forest and open country preferred	available animals in size of insects to rabbits, fruits
-21-29"	chaparral, open forests, rimrock country	chiefly small mammals, also insects, fruits, acorns, birds, eggs

Lynx rufus	Bobcat (?) Bay Lynx		Head & body--25 Tail--5"
			ORDER UNGULATA
Sus scrofa	Wild Boar (?) Feral Swine		Head & body--3
Odocoileus virginianus	Whitetail Deer Virginia Deer		Height--3-3½' Weight--50-400
			ORDER PRIMATES
(Homo sapien)	(Man)		

-30"	swamps and forests	small mammals, birds
(ARTIOCLACTYLA)		
-5'	uplands of pine and deciduous forests	seeds, roots, insects
lbs.	forests, swamps, open brushy areas	twigs, shrubs, fungi, seeds, grass, herbs,

-- NONE

SCIENTIFIC NAME	COMMON NAME	SLIDE	F
Ambystoma opacum	Marbled Salamander		common
Ambystoma maculatum	Spotted Salamander		uncommon
Ambystoma tigrinum tigrinum	Eastern Tiger Salamander		uncommon
Diemictylus viridescens viridescens	Red-Spotted Newt Common Newt		common
Desmognathus fuscus fuscus	Northern Dusky Salamander		abundant
Plethodon cinereus cinereus	Red-Backed Salamander		uncommo
Plethodon glutinosus glutinosus	Common Slimy Salamander		abundan
Plethodon glutinosus chlorobryonis	Green-Sided Slimy Salamander		abundan
Hemidactylium scutatum	Four-Toed Salamander		rare
Gyrinophilus danielsi dunni	Carolina Spring Salamander		uncommo

F DEKALB COUNTY

REQUENCY	AVERAGE LENGTH	HABITAT	DIET
-abundant	3½-4¼ (5)	under logs, bark in lowlands along streams	Salamanders and newts normally feed on small invertebrate animals. They prefer earthworms, insects, and other salamanders, but will also eat snails, slugs, centipedes, etc. They have been known to eat small snakes, amphibian eggs and tadpoles, fresh-water crustaceans, fish eggs, etc.
-common	6-7½" (9)	under logs, stones in damp wooded areas	
	7-8¼" (13)	burrows in ground, breeds in shallow ponds, ditches	
	27/8-4" (5)	adults: ponds, lakes, swamps---efts: in woods under damp logs, bark	
t	2½-4½" (5¼)	under rocks, logs, leaves along margin of springs, streams	
n-common	2¼-3½" (5)	beneath logs, leaves, stones in wooded areas	
t	4 3/4--6 3/4" (7 3/8)	beneath logs, stones in woods	
t	not available	beneath logs, stones in woods	
	2-3½"	under logs, leaves near bogs, marshes, seepages	
n-common	5-7½" (8)	under stones, leaves in springs, streams	

Pseudotriton montanus montanus	Eastern Mud Salamander		uncommo
Pseudotriton ruber ruber	Northern Red Salamander		common
Eurycea bislineata cirrigera	Southern Two-Lined Salamander		common
Eurycea longicauda guttolineata	Three-Lined Salamander Southern Long-Tailed Salamander		common
Bufo americanus	American Toad		common
Bufo woodhousei fowleri	Fowler's Toad		abunda
Acris gryllus crepitans	Northern Cricket Frog Common Cricket Frog		abunda
Hyla crucifer crucifer	Northern Spring Peeper		common

n	$3\frac{1}{2}$-6" (7)	under stones, leaves, logs, in muddy situations near water
	$4\frac{1}{4}$-6" (7 1/8)	under stones, leaves, logs in moist situations
	$2\frac{1}{2}$-3 3/4" ($4\frac{1}{2}$)	beneath stones, logs in moist situations
	4-$6\frac{1}{4}$" (7 1/8)	beneath stones, logs in moist situations
-abundant	2-$3\frac{1}{2}$" ($4\frac{1}{4}$)	most land habitats, breeds in puddles, ponds, lakes
nt	2-3" ($3\frac{1}{4}$)	most land habitats, breeds in shallow waters of ponds, lakes, larger streams
nt	5/8--1 3/8"	among vegetation of moist aquatic situations
	3/4--$1\frac{1}{4}$" (1 3/8)	under litter in dense woods, breeds in open grassy pools, ditches, ponds near woods

Hyla versicolor versicolor	Eastern Gray Tree Frog Common Tree Frog	common
Pseudacris nigrita feriarum	Eastern Chorus Frog Upland Chorus Frog	common-
Microhyla carolinensis carolinensis	Eastern Narrow-Mouth Toad	common
Rana catesbeiana	Bullfrog	common-
Rana clamitans melanota	Northern Green Frog	common
Rana pipiens sphenocephala	Southern Leopard Frog	common-
Rana palustris	Pickerel Frog	uncommo

	$1\frac{1}{4}$-2" (2 3/8)	wooded areas, breeds in thickets of marshes, ponds, lakes	
abundant	3/4--1 3/8"	dense woods, breeds in ditches, pools, ponds	
	7/8--$1\frac{1}{4}$" (1 7/16)	under logs, rocks on ground, breeds in grassy puddles, ponds	
abundant	$3\frac{1}{2}$-6" (8)	larger ponds, lakes, streams	
	$2\frac{1}{2}$-$3\frac{1}{2}$" (4)	along streams, breeds in ponds, lakes	
abundant	2-$3\frac{1}{2}$" (5)	swampy marshes and meadows, breeds in grassy ponds, pools	
n	1 3/4--3" (3 1/8)	along streams and ponds, breeds in grassy ponds, lakes	

Frogs and toads, like salamanders and newts, feed primarily on small invertebrate animals, especially insects and worms. Their diet also includes fresh-water crustaceans, amphibian eggs, and salamanders. They have been known to feed on small turtles, snakes, and even small birds that were slow to move. The tadpole stage normally is herbaceous, feeding on plant life.

REPTILES OF DEKA

SCIENTIFIC NAME	COMMON NAME	SLIDE	FREQU
Chelydra serpentina serpentina	Common Snapping Turtle		common
Sternotherus odoratus	Common Musk Turtle Stinkpot Turtle		common
Kinosternon subrubrum subrubrum	Common Mud Turtle Eastern Mud Turtle		common-
Terrapene carolina carolina	Common Box Turtle Eastern Box Turtle		abundan
Chrysemys picta picta	Eastern Painted Turtle		abundan
Pseudemys floridana concinna	River Turtle River Cooter		uncomm
Pseudemys scripta scripta	Yellow-Bellied Turtle		common
Trionyx ferox	Soft-Shelled Turtle		uncomm
Anolis carolinensis carolinensis	Carolina Anole Green Anole		common-
Sceloporus undulatus hyacinthinus	Northern Fence Lizard		common-

LB COUNTY

ENCY	AVERAGE LENGTH	HABITAT	DIET
	8-12" (18½)	streams, lakes	Most turtles are omnivorous, feeding on both plantsand animals, whereas some feed only on other animals. Food includes pond plants, worms, fish, frogs and salamanders, snakes, birds, fresh-water crustacea, etc.
	3-4½" (5½)	pond, lakes, streams	
abundant	3-4" (5)	streams, ponds, puddles	
t	4½-6" (6½)	woods, especially near water	
t	4½-6" (7)	quiet waters of lakes, ponds, streams	
n	9-12" (13)	larger streams	
	5-8" (11)	ponds, lakes	
n-common	7-18" females 5-8" males	ponds, lakes, streams	
abundant	5-7½"	on trees, shrubs, especially near water	
abundant	4-7¼"	dry, open woods	

Ophisaurus attenuatus longicaudus	Slender Glass Lizard		uncommon
Cnemidophorus sexlineatus	Six-Lined Racerunner		common
Lygosoma laterale	Brown Skink Ground Skink		common-a
Eumeces fasciatus	Common Five-Lined Skink		common
Eumeces laticeps	Greater Five-Lined Skink Broad-Headed Skink		common
Eumeces inexpectatus	Florida Five-Lined Skink Southeastern Five-Lined Skink		uncommo
Agkistrodon contortrix (contortrix)	(Southern) Copperhead		common

	22-42"	grassy fields and dry open woods	The diet of lizards varies greatly, some feeding on plants, others on animals, some on both. The biggest part of the diet is on insects. Also they eat worms, rodents, birds, small snakes, salamanders and eggs of various kinds.
	6-9½"	dry, open areas	
bundant	3-5"	under leaves, debris of wooded areas	
	5-7½"	logs, rock piles	
	6½-12½"	in wooded areas, usually near water	
n-common	5½-8½"	open wooded areas, rock piles	
	24-36" (53)	rocky woodlands	mice, birds frogs

Natrix septemvittata	Queen Water Snake	common
Natrix sipedon pleuralis	Midwestern Banded Water Snake Midland Banded Water Snake	abundan
Storeria dekayi wrightorum	Wright's Brown Snake Midland Brown Snake DeKay's Snake	common-
Storeria occipitomaculata occipitomaculata	Red-Bellied Snake	uncommo
Thamnophis sirtalis sirtalis	Eastern Garter Snake	common
Thamnophis sauritus sauritus	Eastern Ribbon Snake	uncommo
Haldea striatula	Southern Ground Snake Rough Earth Snake	rare
Haldea valeriae valeriae	Eastern Ground Snake Smooth Earth Snake	uncommo
Heterodon platyrhinos	Eastern Hog-Nosed Snake	common
Diadophis punctatus punctatus	Southeastern Ring-Necked Snake Southern Ringneck Snake	common-
Carphophis amoenus amoenus	Eastern Worm Snake	common-

	15-24" (36¼)	along streams,ponds	frogs,fish
t	22-40" (51½)	along streams,ponds	frogs,fish
abundant	9-13" (18½)	under logs, leaves	earthworms, salamanders, slugs, insects
n-common	8-10" (16)	under leaves,logs, debris on ground	worms,slugs insect larva
	18-26" (48)	under stones,logs in and near woods	frogs,fish salamanders
n-common	18-26" (38)	on and under logs, shrubs, usually near water	frogs,fish salamanders
	7-10" (12½)	under bark, logs, stones in woods	worms,slugs salamanders, insects
n	7-10" (12½)	under bark, logs, stones in woods	worms,slugs salamanders insects
	18-30" (43)	dry, sandy habitats	toads,frogs
abundant	10-14" (17½)	under damp stones, logs, bark	worms,slugs salamanders
abundant	7-11" (13)	under stones, logs, bark	worms, insect larva

Coluber constrictor constrictor	Black Racer		common-
Masticophis flagellum flagellum	Eastern Coachwhip		common
Opheodrys aestivus	Keeled Green Snake Rough Green Snake		uncommo
Elaphe guttata guttata	Corn Snake Red Rat Snake		uncommo
Elaphe obsoleta obsoleta	Black Rat Snake		common-
Pituophis melanoleucas melanoleucas	Northern Pine Snake		uncommo
Lampropeltis calligaster rhombomaculata	Brown King Snake Mole Snake		uncommo
Lampropeltis getulus getulus	Eastern King Snake		common-
Lampropeltis doliata doliata	Scarlet Milk Snake Scarlet King Snake		uncommo
Cemophora coccinea	Scarlet Snake		uncommo
Tantilla coronata coronata	Common Crowned Snake Southeastern Crowned Snake		uncommo

abundant	36-60" (73)	thickets near open fields	birds, bird eggs, mice, frogs
	42-60" (102+)	rock piles in fields, open woods	mice, birds frogs
n-common	22-32" (42)	on shrubs, low trees	insects
n-common	30-48" (72)	fields, thickets, old barns, houses near woods	mice, birds
abundant	42-72" (101)	thickets, woods	mice, birds
n	48-66" (83)	under rocks in harwoods or well-drained pine forest	mice, birds
n-common	30-40" (45)	in rodent burrows in fields, thickets	small snakes, lizards, mice, birds
abundant	36-48" (82)	in woods along streams	mice, birds frogs
n	14-20" (27)	in rotten logs, stumps	small snakes lizards, mice
n	14-20" (32½)	burrows in damp soil, under logs	insect larva, small snakes eggs
n	8-10" (13)	under stones, logs on well-drained hillsides	worms, slugs insects, salamanders

MATH ACTIVITIES FOR THE OUTDOORS

These activities have been collected from a variety of sources which are listed at the end of this hand-out. Most are suitable for the upper-grade child (grades 4 - 7). Sometimes the math activity will be part of a science or social studies activity, so some of the activities embrace other disciplines.

Part I: Basic activities which need to be learned before mathematics activities are conducted outdoors.

1) Pacing: Measure a distance of 100 feet. Have child pace normally all the way down and back. Divide the number of paces into 100 feet. This gives you the amount of feet which are included in one normal pacing step. To find out any distance, pace it off, and multiply the number of paces by the number which you obtained on the 100-foot walk.

2) Surveying an area: To mark off an area, use a compass to determine directions. Then determine the number of paces you need to mark off your chosen distance. Use the compass to locate north. Pace in that direction until distance is reached. Use compass to determine 90° angle if area desired is a rectangle (or square). Pace again the desired distance. Continue until area is marked off. Use twine or posts to mark corners.

3) Acreage: To mark off an acre, pace a distance of 66 feet x 660 feet. If you multiply these two numbers, the product is 43,560 square feet, which is the area of one acre. (A new measurement can be introduced here: 1 chain = 66 feet. 10 chains = 660 feet. This measurement is used in forestry and surveying.)

Part II: Activities using numeration and graphing.

1) Know Count: Go outside and count something so you know more about it after you have counted it than you did before you counted it.

bricks
broken windows
sand grains
how much garbage is produced by the school
how much gasoline is sold at a service station
cars in traffic periods
insects
leaves

How can the various things that were counted be related? Should any of the things counted increase or decrease? How could they be made to increase or decrease?

2) Ups and Downs: Find something in the environment that is increasing in number and something that is decreasing in number--and prove it!

number of kids in school
number of leaves during certain seasons
number of flies in the fall

Classify the increases and decreases you found as good, bad, and neutral.

Find some things that increase and decrease but not in numbers.
Find some things that always increase.
Find some things that always decrease.

3) Taking a tree census: Count all the trees of each variety that can be seen in a walk around the block or along a woodland trail. A simple method of tallying can be taught in connection with this activity.

4) Counting and averaging: Find the average number of miles per hour traveled by a bus on a trip. Calculate the average temperature for a week or a month. Count the number of cars passing the school during a certain 15-minute period of the day. Find the average number of children present for outdoor activities each day for a week. Count and tally the number of birds or animals of each kind encountered on a hike.

5) Making graphs: Have the children make tables, charts, or graphs of the data collected in projects such as those described in the preceding activity.

6) Toothpick birds: Materials needed - ball of cord, 4 stakes, graph paper, crayons, colored toothpicks (50 each of red, blue, yellow, green, and pink).

a. Use stakes as corner pegs to form a rectangular garden plot.

b. Push 250 toothpicks of five different colors into the garden plot. Make certain that the colors are well distributed over the area. To avoid breakage, shove each toothpick into the ground at a slight angle. About half an inch of the toothpick should be left showing.

c. Imagine that the class are "toothpick birds". Toothpick birds eat toothpick worms, which are the colored toothpicks. Gather round the garden's perimeter. When the starting signal is given, each pupil or "toothpick bird" pulls out as many toothpick worms as he can see. Stay behind the cord and avoid feeling for toothpicks, as they have sharp points. In two or three minutes the class will receive a signal to stop.

d. All toothpicks collected are sorted into five colored piles. The number of each color is recorded.

e. Put the results into a bar graph, and decide how the results will show protective coloration. Which toothpicks were easiest to find? Which ones were the hardest? If you were a toothpick worm which color would you rather be? How would the time of year affect your results? Name some birds which match their surroundings. How does this pattern help to protect the species?

Part III: Activities using operations (add, subtract, multiply, divide)

1) Measuring how far away lightning is. During an electrical storm, the time interval between seeing lightning and hearing its thunder indicates how far the lightning is from the observer. Sound travels at approximately 1,100 feet per second. The lightning is seen immediately, but the sound of the thunder is heard only after covering the distance at a speed of 1,100 feet per second. If there is an interval of 5 seconds between the flash of the lightning and the sound of the thunder, then the lightning is 5,500 feet (5 x 1,100 feet) away. What is the smallest number of seconds that could be counted between seeing the lightning and hearing the thunder in order to call a storm a distant one? (Ten, because 10 times 1,100 feet is 11,000 feet, just over two miles.) How far has a storm moved toward you if the time interval between the lightning and the thunder changes from eleven seconds to four seconds? (7,700 feet)

2) Devising tree ring problems: Count the rings to find out how many years the tree lived. If it is true that it was cut in 1964, then when did it begin to grow?

Observe the injury to the tree that shows up in the seventh ring from the last. In what year did this injury occur? How old was the tree at that time?

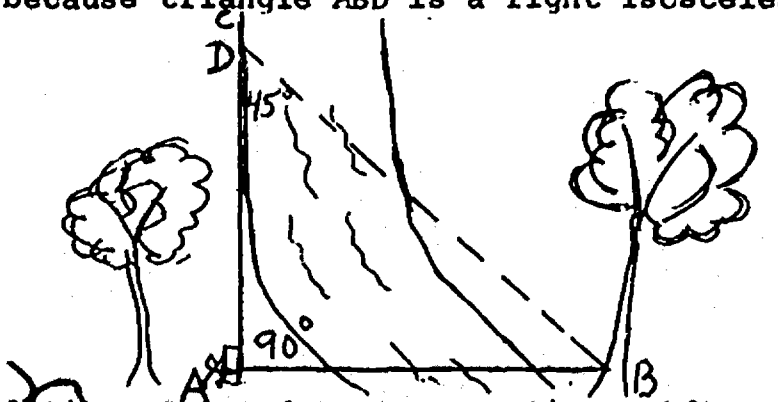
3) Estimating Inaccessible Distances: A distance that cannot be estimated by pacing--for example, the width of a stream--can be estimated with the aid of a protractor.

a. Drive a stake or place a stone at a selected point A. Sight from point A to point B (the location of a rock, shrub, tree, or other object easily sighted on the opposite side). Use a straight stick or a string (or vine) pulled taut to mark this line of sight, AB.

b. By crossing sticks or strings at a right angle (using the protractor for determining the angle), set up a line (AC) perpendicular to AB.

c. Walk along this perpendicular line (AC) until you come to a point, D, where the line of sight from D to B will make an angle of 45° with the line DA. Use a stick or a string to mark this line of sight, and check the 45° angle with the protractor.

d. Pace or measure the distance DA. This distance will be the same as AB, because triangle ABD is a right isosceles triangle.



4) Making Calculations Related to Conservation: After a hard rain, have the children collect the soil that has washed into the street or along a section of the curb. Place this soil in a box, and have the children determine its volume to find out how much soil was washed away at the place where they collected it.

Older children could calculate to what depth that amount of topsoil could cover a square foot of land, or how many square feet it could cover to a depth of one-eighth of an inch. They might also be able to find the number of cubic feet (1 cubic foot equals 1,728 cubic inches) of topsoil that would be lost from a whole acre (43,560 square feet).

5) Determining the Speed of Water Flow: Children are often curious about the speed at which water flows, regardless of whether the water is flowing in a river or in the gutter in front of the school. The speed can easily be determined by floating an object in the moving water and measuring the distance it travels in one minute (or a certain number of seconds).

For example, suppose a small piece of paper or a part of a leaf is carried 176 feet in 1 minute. Then, because there are 60 minutes in 1 hour, it would travel 60 times 176 feet, or 10,560 feet in 1 hour. By dividing 10,560 by 5,280 (the number of feet in a mile), the children would find that the speed of the object and the water carrying it is 2 miles per hour.

You may wish to ask the children to use and explain the following alternative method of determining the speed of water flow:

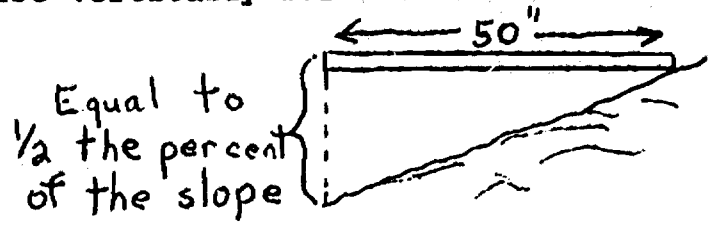
a. Find the number of seconds a floating object takes to travel 100 feet.

b. From the result in the preceding step, determine the number of feet the object travels in one second. (If the object travels the 100 feet in 20 seconds, then dividing 100 by 20 gives 5, the number of feet traveled per second.)

c. Determine the number of seconds in one hour. (3,600) Then multiply this number by the number of feet per second that the object is traveling (refer to part b) to find the number of feet it travels in one hour. (If the object is traveling 5 feet per second, 3,600 times 5 gives 18,000, the number of feet it travels in 1 hour.)

d. Divide the number of feet the object travels in 1 hour (as found in part c) by the number of feet in a mile (5,280) to find the number of miles per hour that is the speed of the object--and the water. (If the object travels 18,000 feet in 1 hour, then 18,000 divided by 5,280 gives 3.4 miles per hour, approximately, as the speed.)

6) Finding the Per Cent of Slope of a Hill: The slope of a hill or a grade may be expressed as a per cent. A 1 per cent slope has a 1-unit rise vertically for each 100 units of horizontal distance.



Use a straight board 50 inches long and rest one end of the board on the side of the hill whose slope is to be found. Raise or lower the other end until the board is level. You may use a carpenter's level if available. Measure the vertical distance from the bottom edge of the board to a point on the ground directly below the end of the board. The number of inches measured is equal to half the per cent of the slope, so you must multiply the number obtained by 2.

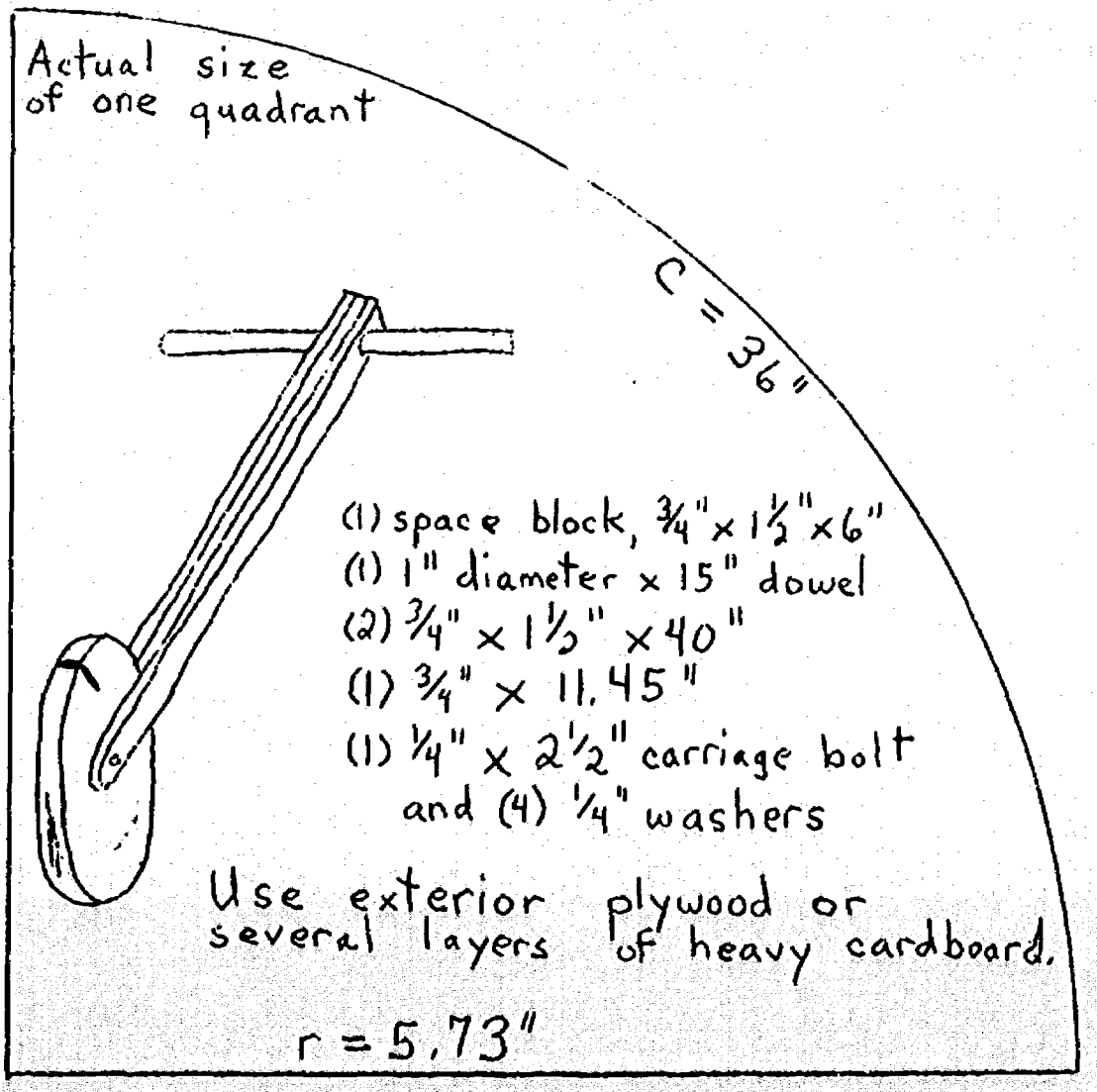
7) Studying the strength of insects: Children have probably watched ants or other insects moving objects many times their size. The children should note that if a child had comparable strength he could move a boulder weighing several tons.

a. If a man weighing 200 pounds could move 20 times his own weight, how many tons could he move? (4,000 pounds, or 2 tons)

b. A stag beetle can lift 120 times its weight. At the same weight ratio, how much could each child lift? (For a 100 pound child, 12,000 pounds or 6 tons.)

c. If a bee flies eight miles per hour, how long would it take to make six round trips to flowers half a mile from the beehive, not counting time at the beehive or at the flowers? (22-1/2 minutes)

8) Measuring Horizontal Distances: To make a circular yardstick, measure and drill a 9/32" hole, 1" from the end of each of the two 40" pieces. Glue the spacer in the other end of the 40" pieces. With a brace and 1" bit, drill a hole in the spacer end of the two 40" pieces. Insert the dowel handle and nail it in place. Cut out a wheel with an approximate 11.45" diameter. Have pupils measure and draw the wheel as close to 36" as possible. (An 11.45" diameter equals 35.97 circumference.) Be certain to find the center of the wheel and drill a 9/32" hole before cutting out the circle. Position two washers on the outside of the 40" handle pieces and fasten the carriage bolt. Make a line on the periphery of the wheel. This line will serve as an indicator mark for measurements.



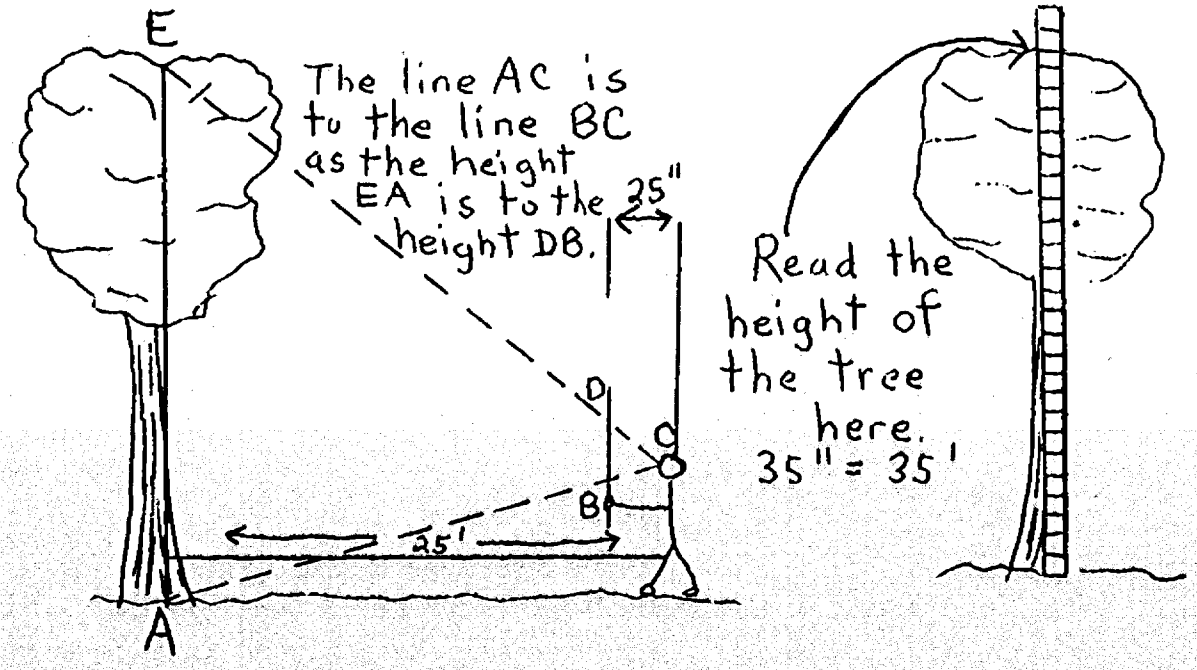
9) Using Crickets as "Thermometers": If the day's temperature is between 55° and 100°, a cricket can help the children to estimate the temperature with reasonable accuracy. To determine the number of degrees of temperature, the children should count the number of times the cricket chirps in 15 seconds and then add 40. Have the children write the formula for finding the number of degrees in the temperature, T, when the number of cricket chirps is represented by C. (T = C + 40)

10) Studying the Travel Rate of Ants: Have the children find a large ant running along the ground and have them measure the distance it travels for a short period of time, perhaps a minute. Then direct them to measure the ant and find how many of its body lengths were represented by the distance it traveled in the period of time that was observed.

Have the children determine how far they would go if they traveled the same number of their own body lengths in the same period of time. Then have them find the rate of speed (in miles per hour) that this would represent.

11) Measuring vertical distances: The Merritt Hypsometer is used for estimating heights of trees. It works on a ratio of 1 inch to 1 foot. To set up the ratio, two similar triangles must be formed. One triangle is with the eye and yardstick, and the other is with the eye and the object to be measured.

a. Hold the stick at arm's length and measure the distance from the eye to the stick in inches. For every inch pace off one foot from the object. For example, if the stick is held 25" from the eye, pace off 25 feet from the tree.

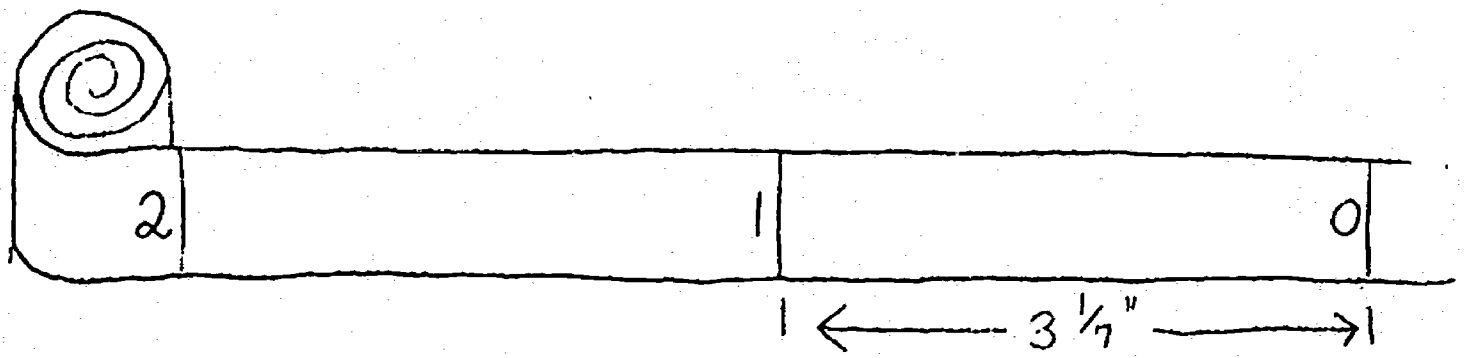


b. Holding your head steady, sight the bottom of the tree along the bottom of the yardstick. Without moving your head, move your eyes to the top of the tree and read the height. The number of inches corresponds to the number of feet.

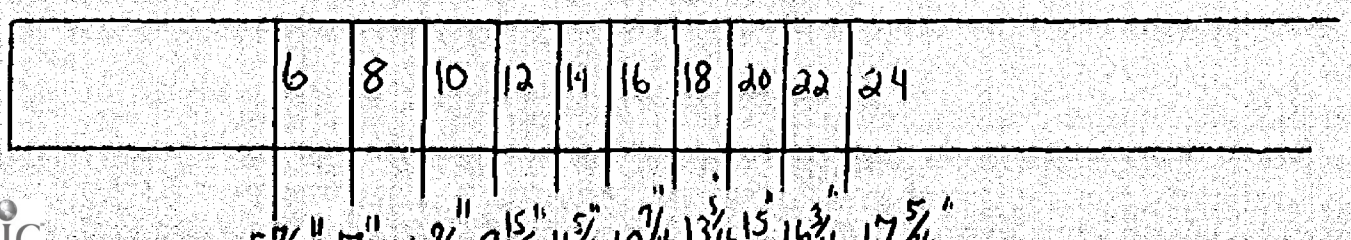
Another method of measuring vertical distances is the Pencil method. Have a person of known height stand beside the tree. Stand at a distance from him and hold a pencil or short stick at arm's length and sight across the top of it to the top of his head, and slide your thumb up or down on the stick until you are able to sight across the top of the thumb to his feet. Move the length of the pencil which you have measured up the length of the tree. Keep track of the number of pencil lengths which you count. The height of the tree is this number times the height of the person.

12) Measuring the diameter of trees: The Diameter Tape determines the diameter of trees. Materials needed are a tape-like material, or two pieces of masking tape back to back. Mark the tape off in 3-1/7 inch sections, as many as you wish. Why 3-1/7 inch sections? It is found if you wind paper around a stick 1 inch in diameter, this paper is 3-1/7 inches long. So every 1 inch diameter of a circle is equal to 3-1/7 inches circumference. This 3-1/7 inch is a constant. It never changes, and it is usually written with the Greek letter pi (π) in the formula $C = \pi D$.

Wrap the tape around the tree trunk 4-1/2 feet above the ground. Where the tape meets, read the diameter in inches.



The Biltmore Stick is also used to estimate the diameter of trees. Materials needed are a yardstick or similar piece of thin wood, and masking tape. Place the tape over the back of the yardstick or piece of wood. Mark off spaces from 6 to 24 using the measurements as seen in the following diagram.



a. Hold the stick horizontally, about four and a half feet from the ground.

b. Hold the stick against the tree, about 25 inches from your eye. Hold your head steady, and line the "O" up to the outside of the tree.

c. Glance at the other side of the stick. The line that lines up with the outside of the tree indicates the diameter.

13) Estimating board feet of lumber: After determining the diameter of a tree, the following chart can be used to estimate the number of board feet of lumber in the tree. Determine the height of the tree by using the Merritt Hypsometer, divide the height by 16. This gives you the number of sawlogs. Locate the number of 16-foot sawlogs in the left column, and then find the diameter in inches along the top column. The number at the point where the columns intersect indicates the number of board feet of lumber in the tree.

CHART FOR ESTIMATING BOARD FEET OF LUMBER

Diameter		10	11	12	13	14	16	18	20	22	24	26	28	30	32	34
Number of Sawlogs	1	39	49	59	71	83	110	140	180	220	270	320	370	420	480	550
	1-1/2	51	64	78	96	112	150	200	250	300	370	440	510	590	680	770
	2	63	80	98	120	141	190	250	310	390	470	560	650	760	870	990
	2-1/2	72	92	112	138	164	220	290	370	460	560	660	780	900	1040	1190
	3	--	--	127	156	186	260	340	430	530	640	770	900	1050	1210	1380
	3-1/2	--	--	--	---	201	280	370	470	580	710	850	1000	1160	1350	1540
	4	--	--	--	---	---	300	400	510	640	770	930	1100	1270	1480	1690

(Instructor Publications)

Part IV: Other activities

1) Mark off quadrants of one square meter in different plant communities to compare: the types of plants, amount of bare ground to that covered with vegetation, amount of basal area of each plant compared to the area covered by the foliage, light intensity, temperature of the air and soil, moisture present, soil compactness, water absorption rate, and air movement.

2) From a sample, estimate the number of leaves on a tree.

3) Compare the relationship between tree circumference and its diameter. Compare the different kinds of trees.

4) Compare the amount of area covered by the tree and shrub canopies of different forest species.

5) Estimate how many seeds that have fallen from a plant have begun to grow. Estimate the total number of seeds that were formed by the plant.

6) Make a population census of small animals in an area.

7) Estimate the number of birds in a flock.

8) Make a survey of insects and the plants on which their evidences are found. Estimate the total number of certain kinds of insects in an area.

9) Compare the temperature of the water to the temperature of the soil around it and to the temperature of the air above it.

10) Determine if the temperature of the air varies in different places (next to a building, under a tree, in shade, in direct sunlight). What factors may cause these differences?

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Wilson, Audrey E. Studying Birds. Toronto: The Ryerson Press, 1970. (Other books in this series are Studying Soils, Studies for Open Places, Studies for Woodlands.)

The Diameter Tape, Biltmore Stick, and Measuring Wheel Quadrant were obtained from the Pennsylvania Outdoor Education Resources Center.

KEY TO SELECTED TREES, SHRUBS, AND VINES

OF FERNBANK FOREST

1. Tree or shrub 2
1. Vine 21

2. Tree with needle-like leaves 3
2. Tree with broad leaves 4

3. Needle-like leaves, 6" to 9" long, in clusters of 3 . . . . . Loblolly Pine *Pinus taeda*
3. Needle-like leaves, 3"to 5" long, in clusters of 5 . . . . . Eastern White Pine *Pinus strobus*

4. Leaves compound 5
4. Leaves simple 8

5. Leaves alternate 6
5. Leaves opposite 7

6. Leaves once compound, mostly with 5 to 7 leaflets - no thorns on trunk . . . . . Hickory *Carya spp.*
6. Leaves twice compound, leaflets 2" to 4" long with finely toothed margins - thorns present on trunk . . . . . Hercules Club *Aralia spinosa*

7. Leaflets distinctly toothed, lenticels prominent . . . . . Elderberry *Sambucus canadensis*
7. Leaflets minutely toothed, lenticels indistinct . . . . . Ash *Fraxinus pennsylvanica*

8. Leaves opposite 9
8. Leaves alternate 12

9. Leaf margin smooth 10
9. Leaf margin lobed 11

10. Leaves unlobed, ends pointed usually more than 2" long . . . . . Dogwood *Cornus florida*
10. Leaves unlobed, ends rounded usually less than 2" long . . . . . Privet *Ligustrum sinense*

11. Leaves 2"-6" long, smooth on underside . . . . . Red Maple *Acer rubrum*
11. Leaves 5"-10" long, fuzzy on underside . . . . . Princess Tree *Pawlonia tomentosa*

12. Leaves lobed 13
12. Leaves unlobed 16

13. Fruit or seed is an acorn 14
13. Fruit or seed is not an acorn 15

14. Leaves with smooth rounded lobes . . . . The White Oaks *Quercus spp.*
14. Leaves with bristle-tipped lobes . . . . The Red Oaks *Quercus spp.*

15. Leaves star-shaped and 5-lobed . . . . . Sweetgum *Liquidambar styraciflua*
15. Leaves 4-pointed and notched at the tip . . . . . Tulip Poplar *Liriodendron tulipifera*

16. Leaves longer than broad 17
16. Leaves as broad as long 20

17. Leaves singly toothed 18
17. Leaves doubly toothed 19

18. Leaves finely toothed - bark rough, red-brown or black - lenticels easily seen on younger trees . . . . . Wild Cherry *Prunus serotina*
18. Leaves coarsely toothed, gradually tapering to a point, bark smooth gray - lenticels not easily seen . . . . . Beech *Fagus grandifolia*

19. Buds greenish - bark gray with vertical ridges giving a muscular appearance - leaf base symmetrical . . . . . Ironwood *Carpinus caroliniana*
19. Buds brown - bark brown or brownish-gray; leaf base not symmetrical . . . . . Elm *Ulmus spp.*

20. Leaves heart-shaped, leaf margin smooth . . . . . Redbud *Cercis canadensis*
20. Leaves heart-shaped, mitten-shaped, and 3 to 5 lobed . . . . . Mulberry *Morus spp.*

21. Leaves simple 22
21. Leaves compound 23

22. Leaves alternate, vines with thorns . . . . . Catbrier *Smilax spp.*
22. Leaves opposite, vines without thorns . . . . . Japanese Honeysuckle *Lonicera japonica*

23. Leaflets 3 . . . . . Poison Ivy *Rhus radicans*
Leaflets 5 . Virginia Creeper *Parthenocissus quinquefolia*